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SERIES I - SPERMATOPHYTA

Flowering Plants

Volume 12, part 2

Caesalpiniaceae, Geitonoplesiaceae
Hernandiaceae, Lowiaceae

Index to revised families in Series I (Spermatophyta)

Aceraceae	4: 3, 592	Connaraceae	Hypericaceae	8: 1; 10: 717	
Actinidiaceae s.s.	4: 37	5: 495; 6: 933; 9: 557	Icacinaceae	7: 1; 9: 566	
Aizoaceae	4: 267	Convolvulaceae	4: 388, 599	Iridaceae	8: 77; 10: 717
Alismataceae	5: 317; 6: 915	5: 558; 6: 936	Ixonanthaceae	10: 621	
Alliaceae	11: 375	7: 823; 9: 558	Juglandaceae	6: 143	
Alseuosmiaceae	10: 335	Coriariaceae	11: 385	Juncaceae	4: 210; 9: 566
Amaranthaceae	4: 69, 593; 6: 915; 8: 549	Cornaceae	8: 85	Juncaginaceae	4: 57
Amaryllidaceae	11: 353	Corynocarpaceae	4: 262; 5: 557	Labiatae	8: 301; 9: 566
Anacardiaceae	8: 395	Crassulaceae	4: 197; 9: 558	Legum.-Mimosoideae	11: 1
Ancistrocladaceae	4: 8	Cruciferae	10: 541	Legum.-Caesalpinioideae	12: 409
Aponogetonaceae	4: 11; 7: 213	Crypteroniaceae	8: 187	Leeaceae	7: 755
Araliaceae—I	9: 1, 553	Ctenolophonaceae	10: 629	Lemnaceae	7: 219
Araucariaceae	10: 419	Cupressaceae	10: 442	Lentibulariaceae	8: 275
Aristolochiaceae	10: 53	Cyperaceae	7: 435; 9: 107	Liliaceae s.s.	9: 189
Balanophoraceae	7: 783; 9: 554	Datisceae	4: 382	Linaceae	10: 607
Basellaceae	5: 300	Dichapetalaceae	5: 305; 6: 941	Loganiaceae	6: 293, 953; 9: 567
Bat(id)aceae	5: 414	Dilleniaceae	4: 141; 7: 824	Lophopyxidaceae	7: 89
Betulaceae	5: 207; 6: 917	Dioscoreaceae	4: 293	Lowiaceae	12: 763
Bignoniaceae	8: 114; 9: 554	Dipsacaceae	4: 290	Magnoliaceae	10: 561
Bixaceae s.s.	4: 239	Dipterocarpaceae	9: 237	Malpighiaceae	5: 125
Burmanniaceae	4: 13, 592; 5: 553; 9: 554	Droseraceae	4: 377; 5: 557; 9: 562	Martyniaceae	4: 216
Burseraceae	5: 209, 567	Elaeagnaceae	10: 151	Meliaceae	12: 1
6: 917; 7: 820; 9: 555		Elatinaceae	4: 203	Menispermaceae	10: 157
Butomaceae	5: 118	Epacridaceae	6: 422	Mimosaceae	11: 1
Byblidaceae	7: 135	Ericaceae	6: 469, 943	Monimiaceae	10: 255
Caesalpinjiaceae	12: 409	8: 549; 9: 562; 10: 716	Erythroxylaceae	Moringaceae	4: 45
Callitrichaceae	4: 251	5: 543; 8: 549	Fagaceae	Myoporaceae	4: 265
Campanulaceae	6: 107, 928; 9: 556	7: 265; 9: 563	Flacourtiaceae	Myricaceae	4: 276
Cannab(in)aceae	4: 222	6: 943; 7: 827; 9: 563	Flagellariaceae	Najadaceae	6: 157
Cappar(id)aceae	6: 61; 7: 822	4: 245; 9: 564	Geitonoplesiaceae	Nyctaginaceae	6: 450
Caprifoliaceae	4: 175; 6: 928; 9: 556	12: 731	Geraniaceae	Nyssaceae	4: 29
Cardiopteridaceae	7: 93	6: 445; 9: 565	Gnetaceae	Ochnaceae	7: 97
Celastraceae	6: 227, 389, 930	4: 336; 6: 944	Gonystylaceae	Olcaceae	10: 1, 717
Centrolepidaceae	5: 421	4: 349	Goodeniaceae	Onagraceae	8: 98
Ceratophyllaceae	4: 41	5: 335, 567	6: 949; 7: 827; 9: 566	Opiliaceae	10: 31
Chenopodiaceae	4: 99, 594; 6: 932; 9: 557	Haemodoraceae	5: 111; 10: 717	Oxalidaceae	7: 151, 829
Chloranthaceae	10: 123	Haloragaceae	7: 239, 828	Papaveraceae	5: 114
Chrysobalanaceae	10: 635	Hamamelidaceae	5: 363	Passifloraceae	7: 405
Clethraceae	7: 139	Hernandiaceae	12: 737	Pedaliaceae	4: 216; 7: 829
Cochlospermaceae	4: 61	Hippocrateaceae	6: 389	Pentaphragmataceae	4: 517
Combretaceae	4: 533; 5: 564; 6: 932	Hydrocharitaceae	5: 381	Pentaphyllaceae	5: 121
Coniferales	10: 337	6: 952; 7: 828	9: 566; 10: 717	Pentastemonaceae	11: 393
		Hydrophyllaceae	4: 207	Philydraceae	4: 5
				Phytolaccaceae	4: 228
				Pinaceae	10: 447
				Pittosporaceae	5: 345; 6: 960
				Plumbaginaceae	4: 107

(continued on inside back cover)

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Volume 12 — part 2 — 1996

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(Ding Hou, K. Larsen & S. S. Larsen — pp. 409–730)

Geitonoplesiaceae

(J.E. Laferrière — pp. 731–736)

Hernandiaceae

(B.E.E. Duyfjes — pp. 737–761)

Lowiaceae

(K. Larsen — pp. 763–774)



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ABSTRACT

Flora Malesiana, Series I, volume 12, part 2 (1996) iv + 409–784, edited by C. Kalkman et al., published by Rijksherbarium / Hortus Botanicus, Leiden, The Netherlands, under the auspices of Foundation Flora Malesiana.

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Contains taxonomic revisions of four families for Malesia (i.e. the area covering the countries Indonesia, Malaysia, Brunei Darussalam, Singapore, the Philippines, Papua New Guinea).

Index to scientific plant names in all four families on pp. 775–784.

Ding Hou, K. Larsen & S. S. Larsen, **Caesalpiniaceae** (Leguminosae–Caesalpinioideae), pp. 409–730.

In Malesia the family contains 25 indigenous genera and 8 genera with only introduced species, as follows (in brackets the number of native and/or introduced species in Malesia): *Acrocarpus* (1), *Azelia* (2), *Amherstia* (1), *Bauhinia* (69), *Brownea* (4), *Caesalpinia* (22), *Cassia* (4), *Chamaecrista* (5), *Copaifera* (1), *Cordia* (28), *Cynometra* (14), *Delonix* (1), *Dialium* (5), *Endertia* (1), *Gleditsia* (1), *Haematoxylum* (1), *Hymenaea* (2), *Intsia* (2), *Kalappia* (1), *Kingiodendron* (3), *Koompassia* (3), *Leucostegane* (2), *Maniltoa* (13), *Parkinsonia* (1), *Peltophorum* (3), *Pterolobium* (5), *Saraca* (8), *Schizolobium* (1), *Senna* (17), *Sindora* (15), *Sympetalandra* (5), *Tamarindus* (1), *Uittienia* (1). Altogether there are 200 indigenous species in the area, and 42 introduced species are also fully treated.

The general family part is by the three authors, except a chapter on palynology (R.W.J.M. van der Ham) and a chapter on phytochemistry and chemotaxonomy (R. Hegnauer). K. & S.S. Larsen contributed *Bauhinia*. The genera *Cassia*, *Chamaecrista*, and *Senna* are authored by K. Larsen & Ding Hou, *Dialium* by J.P. Rojo. Ding Hou contributed the remainder of the genera.

The family introduction covers 21 pages, not including the keys. There are two keys to the genera and one to the 'exotic' genera which are in Malesia only represented by cultivated species. For each accepted taxon, from genus to variety, there is a morphological description/diagnosis, synonymy and references, and paragraphs on habitat/ecology, distribution, uses, etc. Genera with more than one species (in the area) have a key to the species, sometimes two, and also the infraspecific taxa are keyed out.

Genera are arranged alphabetically, as are the species under each genus, only in *Bauhinia* the species are alphabetical under the pertinent subgenus/section.

Illustration is by 47 drawings, most of them full-page, and by five black-and-white photographs.

J.E. Laferrière, **Geitonoplesiaceae**, pp. 731–736.

One of the small liliaceous families, recently described as separate, formerly included in *Luzuriagaceae*, *Philesiaceae*, *Smilacaceae*, or earlier in *Liliaceae*. The family has only two monotypic genera, *Eustrephus* and *Geitonoplesium*, both occurring also in Malesia.

The family and species are described and annotated; there is a key to the genera. A paragraph on palynology is contributed by R.W.J.M. van der Ham.

Illustration is by two full-page line drawings.

B.E.E. Duyfjes, **Hernandiaceae**, pp. 737–761.

In the circumscription as accepted here, the family consists of four genera of which three occur in Malesia: *Gyrocarpus* has 1 Malesian species, *Hernandia* 3, *Illigera* 9. The general family part of 5 pages includes a paragraph on vegetative anatomy by P. Baas, a paragraph on palynology by R.W.J.M. van der Ham, and a paragraph on phytochemistry by R. Hegnauer.

The family, genera, and species are described and annotated; there are keys to the genera and species.

Illustration is by three full-page line drawings and two photographs.

K. Larsen, **Lowiaceae**, pp. 763–774.

A small family, only containing *Orchidantha* with about 10 species, 6 of which occur in Malesia. The general family part of 5 pages includes a paragraph on phytochemistry of *Musaceae sensu lato* by R. Hegnauer, and a paragraph on palynology of *Lowiaceae* by R.W.J.M. van der Ham.

The family and species are described and annotated; there is a key to the Malesian species.

Illustration is by one photograph and two line drawings.

CAESALPINIACEAE
(LEGUMINOSAE–CAESALPINIOIDEAE)

(Ding Hou, Leiden, K. Larsen & S.S. Larsen, Aarhus)¹

Trees, shrubs, scramblers, lianas, or herbs with \pm woody base; evergreen or deciduous; sometimes armed with thorns or spines (*Caesalpinieae*); buttresses sometimes present. *Leaves* usually spirally arranged, bipinnate, pinnate, or unifoliolate, petiolate. *Leaflets* rarely reduced and rachis phyllodial, rarely with pellucid dots. Extrafloral nectaries present in several genera. *Stipules* nearly always present, paired, often caducous; stipels usually lacking, minute when present. *Inflorescences* axillary and/or terminal, or cauliflorous, solitary or fascicled, commonly paniculate, through reduction and condensation leading to simple racemes or spikes and, rarely, to solitary flowers. Bracts and bracteoles usually present, often caducous; bracteoles coloured, enlarged, usually persistent in *Amherstieae*. *Flowers* large to small, often showy, usually bilaterally symmetrical or \pm zygomorphic, less often actinomorphic, bisexual and/or unisexual (then the plants polygamous or dioecious), usually 5-merous except for gynoeceium, mostly perigynous, rarely hypogynous. *Hypanthium* (receptacle) usually present, cupular, tubular, or turbinate, sometimes obscure or absent; the inside often containing nectariferous tissue; other nectar producing organs as discs or other outgrowths at the mouth of the hypanthium. *Sepals* 5 or 4, free or (infrequently) partly united, usually imbricate. *Petals* 5, sometimes reduced to 4(–1), or absent, often unequal, the upper one being the largest, sometimes vexillum-like; usually imbricate-ascending. *Stamens* basically 10, rarely through reduction 5, 3, 2, 1 or in female flowers absent, rarely many; filaments free or variously connected at basal parts; anthers variously developed, basi- or dorsifixed, often versatile, longitudinally dehiscent, rarely by (apical or basal) pores. *Gynoeceium* usually stipitate, rarely sessile, the gynophore often partly adnate to the adaxial wall of the hypanthium. *Ovary* with (1–)few to many anatropous, often superposed ovules in 2 rows on either side of the adaxial suture; style short or long, often curving inward; stigma large or small, capitate or peltate, sometimes obscure. *Fruits* variable, usually oblong to linear or strap-shaped, laterally compressed, straight or curved, dehiscent and 2-valved, valves chartaceous, fleshy, coriaceous, thick, or woody; indehiscent and drupaceous or samaroid; with or without pulp; glabrous, hairy, or spiny. *Seeds* varying in shape, often flattened; testa membranous, coriaceous, or crustose; sometimes arillate; endosperm present or lacking; cotyledons fleshy or foliaceous; radicle straight or slightly oblique, never folded.

1) With contributions by: R.W.J.M. van der Ham, Leiden (palynology), R. Hegnauer, Leiden (phytochemistry), J.P. Rojo (*Dialium*). The drawings and photographs are from different sources, as indicated.

DISTRIBUTION

The *Caesalpinaceae* are a predominantly tropical group of c. 160 genera with c. 2000 species. The greatest number of genera is found in tropical Africa and tropical America. In *Malesia* there are 25 indigenous genera, containing 200 native species and more than 30 cultivated, introduced, or naturalized ones. In addition there are also at least eight commonly introduced or widely cultivated genera with twelve species.

Very few genera occur in the subtropical zones and only three reach the temperate regions, i.e. *Cercis*, *Ceratonia* and *Gleditsia*; the last one is also represented in *Malesia*.

The largest genus is *Bauhinia* with more than 300 species throughout the tropics; it has c. 70 species in *Malesia*, c. 60 in Indochina and c. 40 in S China. Several species are endemics of very restricted distribution. *Cassia* is mainly neotropic and so are the segregate genera *Senna* and *Chamaecrista*. *Caesalpinia* is pantropic with 19 indigenous species in *Malesia*. Most other genera are relatively small and several restricted to tropical Asia. Few genera have a disjunct distribution as e.g. *Copaifera* occurring in tropical America, tropical Africa, and Borneo, and *Gymnocladus* in eastern N America and eastern Asia.

FOSSILS

Fossil records of the *Caesalpinaceae*, which have been attributed back to the Upper Cretaceous, are scarce but from several sites on the Northern Hemisphere. The first caesalpinoid fossils are best referred to the genera *Gleditsia* and *Gymnocladus*, genera which also in floral morphology are among the most primitive taxa in the family. From Middle Miocene in Europe a wide diversity of caesalpinoid fossils are found. For fossil pollen, see the paragraph on Palynology (p. 416).

Literature: Awasti, N., Indian fossil legumes, in: P.S. Herendeen & D.L. Dilcher (eds.), *Adv. Leg. Syst.* 4 (1992) 225–250. — Gregor, H.J. & R. Hantke, Revision der fossilen Leguminosengattung *Podogonium* Heer (= *Gleditsia* Linné) aus dem europäischen Jungtertiär. *Feddes Rep.* 91 (1980) 151–182. — Guinet, Ph. & J.K. Ferguson, Structure, evolution, and biology of pollen in Leguminosae, in: C.H. Storton & J.L. Zarucchi (eds.), *Adv. Leg. Biol., Monogr. Missouri Bot. Gard.* 29 (1989) 77–103. — Herendeen, P.S., A reevaluation of the fossil genus *Podogonium*, in: P.S. Herendeen & D.L. Dilcher (eds.), *op. cit.* (1992) 3–18. — Herendeen, P.S. & P.R. Crane, Early caesalpinoid fruits from Palaeogene of southern England, in: P.S. Herendeen & D.L. Dilcher (eds.), *op. cit.* (1992) 57–68. — Herendeen, P.S., W.L. Crepet & D.L. Dilcher, The fossil history of the Leguminosae: phylogenetic and biogeographic implications, in: P.S. Herendeen & D.L. Dilcher (eds.), *op. cit.* (1992) 303–316. — Muller, J., Fossil pollen records of extant angiosperms. *Bot. Review* 47 (1981) 1–142. — Muller, J., Significance of fossil pollen for angiosperm history. *Ann. Missouri Bot. Gard.* 71 (1984) 419–443. — Müller-Stoll, W.R. & E. Mädel, Die fossilen Leguminosen-Hölzer. *Palaeontographica B*, 119 (1967) 95–174. — Polhill, R.M. & J.E. Vidal, *Caesalpinieae*, in: R.M. Polhill & P.H. Raven (eds.), *op. cit.* (1981) 81–95. — Raven, P.H. & R.M. Polhill, Biogeography of the Leguminosae, in: R.M. Polhill & P.H. Raven (eds.), *Adv. Leg. Syst.* 1 (1981) 27–34. — Van Campo, M., Quelques réflexions sur les pollens de *Sindora*. *Grana* 4 (1963) 361–366.

HABITAT AND ECOLOGY

The *Caesalpinaceae* occupy a wide range of biotopes. Some species are restricted to the evergreen rain forest as, e.g., *Koompassia* with 2 species of very large evergreen forest

trees; among the components of the evergreen forests could also be mentioned species of *Sindora*, *Intsia* and *Saraca*. *Bauhinia* consists of a large number of woody lianas, some of which are also typical rain forest species, others mainly belong to the vegetation along forest margins and to open, deciduous forests, and others again are species characteristic of the drier savanna forests. Some species of *Caesalpinia* belong to the communities of the drier parts of Malesia and some are also found in the inner mangrove vegetation. Pioneer species on cleared land are found among the species of *Cassia* and *Senna*; and some *Senna* and *Chamaecrista* are predominantly weedy.

POLLINATION

Most species have maintained self-incompatibility but observations are scarce. Primitive *Caesalpiniaceae* appear to rely on colour contrast between anthers and petals; in advanced genera as, e.g., *Parkinsonia*, *Caesalpinia* and some *Bauhinia* species nectar guides are evident. In *Caesalpinia* the upper petal and anthers are UV-absorbant. *Xylocopa* bees have been recorded as visitors in, e.g., *Cassia*, *Bauhinia* and *Caesalpinia*. Butterfly pollination is known from Africa and the Americas; K. & S.S. Larsen have observed butterfly pollination of *Bauhinia nervosa* and *B. glauca* in N Thailand (unpublished). Bird pollination is of some importance in South America and bat pollination has been observed in *Bauhinia* and *Caesalpinia* in Costa Rica and Mexico.

A number of characters important for the pollination system of *Bauhinia* has not yet been studied; e.g. the nectariferous disc present in several species of the *Lasiobema* group and the peculiar red outgrowth on the mouth of the hypanthium in *B. bracteata*. The opening of the anthers by pores, usually indicating buzz pollination, is found in *Senna*, *Chamaecrista* and the *Palmatifolia* group of *Bauhinia*, common all over Malesia, but it has yet to be studied in nature. Within the same group the nectar-like fluid produced by the pollensacs and excreted through the pores with the pollen may also be of importance to pollinators. Many *Caesalpiniaceae* are also showing a colour change from the young to the mature flower; in several *Bauhinia* species the colour changes from yellow or orange to red. Extrafloral nectaries are present in species of *Amherstia*, *Caesalpinia*, *Chamaecrista*, *Delonix*, *Intsia*, *Kingiodendron*, *Maniltoa*, and *Senna*.

Literature: Arroyo, K.T.K., Breeding system and pollination biology in Leguminosae, in: R.M. Polhill & P.H. Raven (eds.), *Adv. Leg. Syst.* 1 (1981) 723–769. — Endress, P.K., *Diversity and evolutionary biology of tropical flowers* (1994) 511 pp. — Schrive, B.D., A multidisciplinary approach to pollination biology in the Leguminosae, in: C.H. Stirton & J.L. Zarucchi (eds.), *Adv. Leg. Biol.*, Monogr. Missouri Bot. Gard. 29 (1989) 183–242.

DISPERSAL

The fruits and seeds vary considerably, suggesting a variety of dispersal methods. Here as with the pollination biology, observations in nature are scarce. The samaras of *Pterolobium* clearly have wind dispersal; the heavy fruits, however, do not fly over long distances. In *Koompassia* dispersal by wind has been observed by Ridley (1930). The trees reach a height of over 50 m, overtopping the highest jungles, and the trees are often left

untouched in clearings because of the very hard wood. The samaras have a slow flight, lying horizontally in the air and rapidly rotating; they have been observed to land c. 20 m from the mother tree, but most certainly they are able to fly over much longer distances.

The arillate seeds of genera as, e.g., *Afzelia* and *Sindora* are, after they have reached the ground, attacked by rats and other rodents; it is also suggested by Ridley that the spiny pods of some *Sindora* species are spread epizoid. *Dialium* pods are dispersed by monkeys and birds. The peculiar indehiscent pods of *Cassia fistula* will also attract animals. Dispersal by water currents is, however, also demonstrated for this species and for, e.g., *Senna siamea* on the Malay Peninsula. *Senna alata* with winged pods could be spread by water over shorter distances; it is in any case often found along water courses. Dispersal by water currents was observed for several species of *Caesalpinia* in the Malesian area. *Afzelia bijuga*, which is a common trees in the tidal zone, is also spread by sea currents. There are reports of monkeys feeding on several species of *Senna*. Bird dispersal is shown for other *Senna* species. In several *Bauhinia* species the pods open explosively spreading the seeds up to 12 m according to Kerner cited in Ridley (1930).

Reference: Ridley, H.N., The dispersal of plants throughout the world (1930).

MORPHOLOGY

Growth habit — Besides trees and shrubs, which are the most common life-forms, few are herbs or woody scramblers often with nodal spines, others are lianas with complex wood structures. Among the lianas there is also a great diversity from thin vines as *Bauhinia curtisii* to strong woody lianas as *B. scandens* with flattened stems or *B. aureifolia* in Peninsular Thailand with a basal diameter of 1 m. The lianas in the genus *Bauhinia* are all tendrilled; the tendrils appear at least in some cases to be modified leaves, they are often paired and arise one each from two nodes becoming adjacent as result of suppression of an internode.

Leaves — The leaves are usually spirally arranged, but in the relict genus *Ceratonia* opposite or subopposite. They are bipinnate in *Caesalpinia* and some other genera, but most groups have pinnately compound leaves, often showing within the genus a gradual reduction in number of leaf-pairs, from species with numerous pairs to a single pair or a single leaflet. The petiolules are usually unspecialized but in *Afzelia* and *Crudia* they are twisted. Stipules are nearly always present, often interpetiolar. Intrastipular spines and trichomes are present in some groups of *Bauhinia*, particularly in America, but in Malesia found in, e.g., *B. viridescens*. Extrafloral nectaries (glands) among the leaflets or on the petiole are found in *Senna* and *Chamaecrista* where they offer excellent taxonomic characters. Swollen and myrmecophilous petioles are found in extra-Malesian groups. Ant domatia have been described in two S American and six African genera; in Asia only in the Indian genus *Humboldtia*. Glandular dots caused by translucent resin ducts are found in the tribe *Detarieae*.

Inflorescences — Inflorescence types are various: most commonly paniculate, in other cases reduced to racemose, spicate, or even 1-flowered inflorescences. Usually they are terminal or axillary on the young branches, but cauliflory does occur in few genera. Bracts and bracteoles are variously developed; in the tribes *Detarieae* and *Amherstieae* the bracteoles are enlarged and often enclosing the flowers before anthesis; they are in these groups often persistent while in other tribes they are most often caducous. When the bracteoles are strongly developed a reduction of the calyx is often observed.

Flowers — The hypanthium is a characteristic feature. It is developed in various ways, from almost absent in very few genera to a low, cup-shaped, sometimes zygomorphic structure, to long and tubular as in some *Bauhinia* species. The hypanthium probably is of a complex nature, consisting of fused torus and perianth bases. Often, but not always, it is nectariferous. As the stipitate ovary is often inserted on the side or at the mouth of the hypanthium there is a close resemblance between the structure of the *Bauhinia* flower and the flowers of the *Chrysobalanaceae*, a family in which the style, however, is gynobasic, as is never the case in the *Caesalpinieaceae*.

Floral morphology shows a great deal of variation from small, almost regular flowers, similar to the mimosoid flowers, to large zygomorphic ones with a papilionoid similarity. The simplest floral structures with regular pentamerous flowers and often with 10 stamens are found in the tribe *Caesalpinieae*. In *Gymnocladus* and *Gleditsia* the flowers are effectively unisexual or polygamous, collected in racemes or small panicles. The sepals are not covering the petals in bud. *Acrocarpus* has more robust flowers with sepals almost covering the small, greenish petals spreading during anthesis and exposing a red cupular hypanthium. Similar primitive structures are found in *Erythrophloeum* and here the presence of root nodules also suggests a close link to the *Mimosaceae*. In the *Peltophorum* group, mainly found in the Neotropics, the flowers develop from rather small, simple types over larger ones as in *Peltophorum* to very large, showy flowers in *Delonix*. In *Caesalpinia* and related genera as *Pterolobium* large zygomorphic flowers occur with winged dehiscent or indehiscent fruits often with a reduced number of ovules and seeds; further a variety of defence systems in the vegetative parts and fruits in the form of thorns and bristles are found.

In the tribe *Cassieae* there is a rich variety of floral structures from the small, regular, apetalous, polygamo-dioecious flowers of the relict genus *Ceratonia* over other small-flowered genera as *Dialium* with cymose, paniculate inflorescences to the often large, complexly structured flowers of *Cassia*, *Senna* and *Chamaecrista*. Particularly the development of the androecium in these last three closely related genera shows a unique diversity; basically they are 10-merous, often strongly accrescent towards the abaxial side except in *Chamaecrista*.

In the small tribe *Cercideae* the hypanthium is usually well developed and the flowers vary from small, almost regular pentamerous to large and irregular, with reduction mainly in the androecium (see further under the genus *Bauhinia*).

The floral morphology in the tribe *Detarieae* is the most diverse in the whole of the *Caesalpinieaceae*, as Cowan & Polhill (1981) express it: "in no other part of the family

has one basic type of flower been modified repeatedly in so many different ways." As a basic floral type the genus *Cynometra* has small, regular, pentamerous flowers with a cupular hypanthium; from this, zygomorphic flowers develop and reductions as well as multiplications in the androecium occur. There is also a great variation in the nectarial structures.

The small tribe *Amherstieae* is in its floral structures closely related to the *Detarieae* and particularly to the *Cynometra* type.

The caesalpinoid pistil comprises a single unilocular ovary. In an old specimen of *Bauhinia aurea* from China flowers with several carpels per flower have been observed (unpubl.) in the Jardin Botanique at Paris. In a collection of *B. variegata* from Myanmar (*Sittang C 137613*, CAL) two free carpels of normal size were observed in one flower, in two flowers one normal and one abortive carpel were found. However, it seems that only one carpel develops into a mature pod (personal comm. by S. Bandyopadhyay, Calcutta).

Fruits and seeds — Fruits also vary considerably from the up to 80 cm long, indehiscent, terete pods of *Cassia*, in which the cavity is divided by transverse septa, to the smaller, flattened, elastically dehiscent pods of *Chamaecrista* and the variability of pod shape and size in *Senna*. In other genera the fruits are cordate, falcate, linear, ovoid, strap-shaped, reniform, samaroid, etc. The base may be truncate, rounded, or tapering; apically the same forms are found, and often the style becomes lignified and persistent. The stipe or gynophore also becomes lignified and often lengthens during maturity, up to 14 cm, usually much shorter, however.

The fruit surface is glabrous and shining or covered with an indumentum, or in species of *Sindora* and *Caesalpinia* by spines. In *Sindora* resinous globules are excreted. The number of seeds ranges from many to one; the funiculus varies also considerably, from straight to curved, contorted or hooked. An aril is known to be present in c. 20 genera.

Corner (1951, 1976) stated that the leguminous seed, in some cases, enlarges and fills the seed-cavity of the pod without differentiation of the features of the leguminous testa. Such seeds conform with the size of the pod and have the nature of tumours. Corner referred to them as 'overgrown seeds'. He found that such seeds also occur in some genera of the *Caesalpinieae*, for example, *Bauhinia* (p.p.), *Brownea*, *Cynometra*, *Dialium*, *Koompassia*, and *Saraca*.

A pleurogram is found in four genera, of which only *Senna* occurs in Malesia; this is a marked difference from the *Mimosaceae* where 60% of the genera are provided with a pleurogram. The fracture lines along the outer edge of *Erythrophloeum* may look like a pleurogram. Pseudopleurograms are present in *Lysidice* and *Tamarindus*. Winged seeds are found in two genera, none of which are present in Malesia.

The hilum is a simple, unspecialized structure compared with the papilionoid hilum, and can be described as punctiform and of little diagnostic value. The lens, however, varies to some extent and is of some taxonomic importance. Endosperm is found perhaps in half the genera of the *Caesalpinieae* but most commonly in genera in the tribes

Caesalpinieae, *Cassieae*, and *Cercideae* while it is more rare in the *Detarieae* and *Amherstieae*. The radicle is straight to deflexed and not concealed by the cotyledons.

Keys to fruits and seeds are found in Gunn (1991).

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VEGETATIVE ANATOMY

One of the characteristics of the *Leguminosae* is the root nodule caused by fungal symbiosis. With few exceptions nodulation is the rule in the *Mimosaceae* and *Papilionaceae*, it is rare within the *Caesalpinieaceae*. Our knowledge is still limited and some results are contradictory. In two genera, however, nodules have been induced experimentally, i.e. *Chamaecrista* and *Erythrophleum*; it has also been induced in *Swartzia*, a genus now placed in the *Papilionaceae*, but formerly in the *Caesalpinieaceae*. *Erythrophleum* is also a 'marginal' genus or, as Corby (1981) expressed it "lies near the vague border between *Mimosoideae* and *Caesalpinioideae*." This leaves us with *Chamaecrista*, and the occurrence of root nodules here is also one of the characters that Irwin & Barneby (1981) have used to support the separation of this group from *Cassia*.

The epidermis is often papillose and sometimes mucilaginous. Stomata structure is diverse, two main types are found, paracytic and anomocytic. Tanniferous cells are common in the cortex and phloem. Secretory cavities and canals sometimes occur. The vascular bundles of the leaf veins are often accompanied by sclerenchyma. Solitary and clustered crystals can be found in all parts of the plants; cluster crystals are particularly characteristic of the mesophyl and thus differentiate the *Caesalpinieaceae* from the *Papilionaceae* and *Mimosaceae*. The pericycle of the young stem nearly always contains a continuous ring of sclerenchyma, or a continuous ring of fibres. Grooved stems occur in some species of *Bauhinia*, *Cassia* and *Senna*. In *Bauhinia* the stems of the lianas are sometimes flattened, forming 'monkey ladders'. Anomalous thickening is another characteristic feature of the lianas in *Bauhinia*; this includes types with successive growth rings and segmented xylem.

The wood anatomy is best known for the many valuable timber trees (Ilic 1991; Quirk 1983; Sudo 1988, 1991). Generally the wood is characterized by few specialized characters. Baretta-Kuypers (1981), in her survey of the wood anatomy of the family concludes further that the *Caesalpinieaceae* and the *Papilionaceae* anatomically merge into each other, while the *Mimosaceae*, on the other hand, seem to be quite distinct in their wood anatomy.

Below family level the wood structures usually provide good diagnostic characters, which often agree well with the groups based on the morphology. Two groups may be distinguished on the basis of ray features as well as parenchyma characteristics: 1) *Caesalpinieae*, *Cassieae* and *Cercideae*; 2) *Detarieae* and *Amherstieae*. In the first group the rays are mostly homocellular, in the second they are predominantly heterocellular.

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PALYNOLOGY

(R. W. J. M. van der Ham)

The pollen morphology of the *Caesalpinieae* has been relatively well-studied. However, most of the literature (see Tissot 1990) consists of pollen-floristic contributions, each of which describes few species from a more or less limited area only. The treatment of the *Caesalpinieae* from Madagascar by Senesse (1980) is one of the few more extensive regional accounts, providing many detailed light and scanning electron micrographs. The surveys by Graham & Barker (1981) and Ferguson (1987), scanning and transmission electron microscopical studies respectively, constitute together a comprehensive treatment of the whole family.

The *Caesalpinieae* are distinctly eurypalynous. The most widespread pollen type, found in all tribes and representing a general and comparatively unspecialized angiospermous type, is the tricolporate, small- to medium-sized monad with perforate to reticulate ornamentation, and an exine consisting of a well-developed endexine and foot layer, a distinct columellate infratectum and relatively thick tectum. However, distinctive specializations also occur in all tribes, especially in the *Cercideae* (*Bauhinia*), *Detarieae* and *Amherstieae*, involving aperture as well as exine features. A mixed columellate/granular infratectum occurs randomly throughout the family. Pollen in permanent tetrads is found in three genera in widely separated tribes (Ferguson & Banks 1994; see below).

In the tribe *Caesalpinieae* a number of genera is characterized by small colpi which are surrounded by a broad membranaceous margo (margocolpus) that sometimes extends to the poles (synmargocolpus). Coarsely reticulate ornamentation is found in *Arapatiella*, *Arcoa*, *Chidlowia* and *Delonix*, often associated with short or indistinct ectoapertures. All species of *Diptychandra* have acalymate tetrads, while those of *Jacqueshuberia* have thread-like structures connecting large (c. 80 µm) monads with highly sinuous muri (see also Patel et al. 1985). Several representatives of the tribe have minute holes (foramina) within their ectexine.

Most genera of the tribe *Cassieae* have the general pollen type of the family. The genus *Koompassia* and one *Dialium* species have a striate exine. *Ceratonia* has tricolporate as well as tetracolporate species. Pollen of *Duparquetia* may be unique in the angiosperms in having two polar pores (one distal, the other proximal) in a meridional circular colp.

The genera of the tribe *Cercideae* possess the general pollen type. However, the genus *Bauhinia* is extremely diverse, showing also features as large (up to 120 µm) grains, 5–7-colporate or -porate aperture system, inaperturate grains, a mixed columellate/granular or nearly completely granular infratectum, and striate, verrucate, gemmate to echinate ornamentation (see e.g. Larsen 1975; Ferguson & Pearce 1986; Ferguson 1990). Calymate and acalymate tetrads occur in *B. phoenicia* and *B. pottsii*, respectively.

The *Detarieae* is palynologically the most diverse and complex tribe. The commonest pollen type, often with large conspicuous endoapertures, shows a wide range of intergrading ornamentation types. *Eperua* has triangular, ± brevicolporate pollen. Pantoporate pollen occurs in *Hardwickia* (scabrate) and *Colophospermum* (reticulate). Syncolporate pollen is found in *Baikiaea*, and some *Afzelia* species have acalymate tetrads.

Pollen of the tribe *Amherstieae* is tricolporate and usually striate. *Polystemonanthus* pollen is ± perforate with psilate margos. *Brachystegia* has large (c. 80 µm) coarsely reticulate pollen with finely reticulate poles. Both *Detarieae* and *Amherstieae* show a trend towards loss of the foot layer.

Special modes of pollination may in several cases explain resemblances in ornamentation in not closely related taxa. For instance, large pollen grains with conspicuous supratectal verrucae may be associated with bat pollination in *Dicymbe* (*Amherstieae*), *Bauhinia* (*Cercideae*) and several genera belonging to the *Detarieae*. Tetrads and viscin threads might be adaptations promoting multiple fertilization. The two related genera *Hardwickia* and *Colophospermum* are supposed to have wind pollination, which may be associated with the pantoporate, thin-walled morphology of the exine.

The oldest fossil *Caesalpinioideae* pollen, the *Sindora* type (*Detarieae*), dates from the Maastrichtian of Siberia, and many records from the Tertiary are known (Muller 1981; Herendeen et al. 1992): *Crudia* type, *Maniltoa grandiflora* type, *Caesalpinia* type, *Brachystegia* type, *Eperua* type and *Cassia* type. From this palynological evidence it appears that by the lower Eocene the tribes *Caesalpinieae*, *Detarieae* and *Amherstieae* are known to have been present.

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CYTOLOGY

About half of the genera in the *Caesalpiniaceae* have been studied cytologically with regard to the chromosome numbers. Two major groups emerge, corresponding well with the current overall classification. The first group include the tribes *Caesalpinieae*, *Cassieae* and *Cercideae* with basic number $x = 7$ or 14 ; there are exceptions as, e.g., *Acrocarpus*, *Pterolobium* and *Erythrophleum* with $x = 12$ and in *Cassia sensu lato*, where the chromosome cytology is quite complex with a high degree of polyploidy and aneuploidy. In *Chamaecrista* $x = 7$ and 8 have been found, probably due to derived descending aneuploidy from ancestors with $x = 14$. In *Bauhinia*, where more than 50 species have been studied, most are diploid with $2n = 28$, some are polyploid and some have deviating numbers, e.g. $2n = 26$, found in several species in Asia and Australia. Diploidy is only found in *Cercis* with $2n = 14$.

The second group, comprising the tribes *Detarieae* and *Amherstieae*, has mostly the basic number $x = 12$.

Several old chromosome counts have shown to be erroneous and in most cases where the basic number $x = 8$ has been suggested previously this has been shown to be incorrect. Much work has yet to be done before a clear pattern of the cytological conditions is established.

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PHYTOCHEMISTRY AND CHEMOTAXONOMY

(R. Hegnauer)

General remarks — Phytochemistry of *Mimosaceae* was already treated in Flora Malesiana I. 11 (1992) 15–27. For general comments and references to comprehensive phytochemical legume publications the reader is referred to this '*Mimosaceae*-treatment'. For the present phytochemical summary I chose a similar arrangement of chemical compounds as was used in the general part of Hegnauer's comparative chemistry of Leguminosae (Hegnauer 1994), where many additional references to all classes of phytoconstituents mentioned here are available.

Storage products of seeds — Mature seeds of *Caesalpiniaceae* lack starch or contain only small starch grains (Smith 1983; Hegnauer & Grayer-Barkmeijer 1993). Carbohydrates other than starch (reserve celluloses; oligosaccharides) and proteins are the main storage products of caesalpinoid seeds. Sometimes appreciable amounts of triglycerides (fatty oils; see later) are also present. Reserve celluloses are of two types. *Amherstieae* and *Detarieae* deposit the heteropolysaccharide amyloid in the cell walls of their large cotyledons. Seeds of many *Caesalpinieae*, *Cassieae* and *Cercideae* are copiously provided with an endosperm of thick-walled cells which store galactomannans. This galactomannan character is known from all three legume families and is of economic importance (Locust Bean Gum; Guar Gum). Besides carbohydrates, seeds of

all *Leguminosae* contain large amounts of proteins which are reserve substances (e.g. legumins, vicilins), but may combine other functions with their role as N-containing storage products (see p. 16 of the *Mimosaceae*-treatment). Storage proteins of seeds are deposited in the so-called protein bodies which occur in practically all cells of the embryo (Smith 1983) and in cells of the endosperm. Seeds of all *Leguminosae* also contain triglycerides (fatty oils), but their amounts vary widely. Lipid contents and composition of seeds of *Caesalpinaceae* were studied by many authors. As a rule triglycerides form the largest part of caesalpinaceous seed lipids and lipid contents vary between 2% and 30%, but contents surmounting 10% are rare in this taxon, if the genus *Bauhinia* (12–20%; 5 species investigated) is excluded. Fatty acid profiles of seed oils are characteristic of certain genera, but there does not exist a distinct pattern for *Caesalpinaceae* as a whole. Seed oils of *Bauhinia* contain 16:0, 18:0, 18:1 and 18:2 as predominant fatty acids. Oils of seeds of *Afzelia* (inclusive of *Pahudia*) contain large amounts of crepenynic and dehydrocrepenynic acids and minor amounts of arachidic, behenic and lignoceric acids (20:0, 22:0, 24:0). The *Cassia* seed oils hitherto investigated have 16:0, 18:1 and 18:2 as predominant fatty acids, but in *Cassia grandis* and *Senna* (*Cassia siamea*) oils the presence of minor amounts of the Halphen-positive cyclopropenoid sterculic and malvalic acids was detected. The same unusual fatty acids also occur in the seed oils of *Delonix regia* and the papilionoid taxon *Crotalaria retusa*. Leguminous seeds also store mono- and oligosaccharides, inositols and non-proteinogenic amino acids. Inositols and nonprotein amino acids will be treated later. The characteristic oligosaccharides of *Leguminosae* are raffinose, stachyose and verbascose, i.e. representatives of the so-called raffinose-stachyose series of sucrose- α -galactosides. The raffinose-stachyose sugars occur in seeds of most leguminous plants, but are usually lacking in their vegetative parts. The stachyose sugars are rapidly metabolized during early stages of germination. This is the reason why sprouts of soya, alfalfa and other grain legumes are usually more wholesome than ungerminated seeds which often produce flatulence on account of interactions between intestinal bacteria and the indigestible sucrose- α -galactosides.

Leaf proteins and proteins of vegetative storage organs — Legumes have relatively protein-rich leaves. Because legumes and grasses are most important fodder plants, their leaf proteins were often studied. There seem to exist characteristic quantitative differences between the composition of leaf proteins of the two families. Legume leaf proteins contain larger amounts of arginine, aspartic acid, histidine, phenylalanine and proline, and lesser amounts of alanine and serine. Within *Leguminosae* leaf proteins of *Caesalpinaceae* are similar to those of *Papilionaceae*, but seem to differ from those of *Mimosaceae* by being poorer in glutamic acid and histidine and richer in aspartic acid, phenylalanine and threonine (Yeoh et al. 1984, 1992). Roots and tubers of legumes contain much more protein than similar food plant products, such as batatas, manioe, potatoes and yams. Roots of *Bauhinia esculenta*, e.g., contain about 8.5% of crude protein, dry weight (= about 1.5% of fresh weight).

Inositols (= cyclitols) — Most *Leguminosae* synthesize and store methyl ethers of cyclitols in leaves and seeds. Pinitol and several pinitol galactosides occur in a large

number of species of all three legume families. In some taxa pinitol is replaced or accompanied by other methyl ethers, such as bornesitol and ononitol. Bornesitol and ononitol are monomethyl ethers of *myo*-inositol, and pinitol is a monomethyl ether of (+)-*chiro*-inositol. Ononitol was also isolated from leaves of *Senna (Cassia) obtusifolia* (Matsuura et al. 1978). *Leguminosae* synthesize pinitol by epimerisation of ononitol (Dittrich & Brandl 1987). Inositols and their methyl ethers belong to the so-called 'compatible solutes', i.e. water-soluble metabolites, which can be rapidly produced if there is a need to enhance the osmotic potential of the cells; 'compatible solutes' do not affect enzyme activities, even if they are present in the cells in high concentrations. Pinitol and related cyclitols seem to be involved in adaptation to arid conditions in many leguminous taxa.

Organic acids — Most *Leguminosae* accumulate large amounts of organic acids and, to some extent, acid profiles seem to be more or less taxon-characteristic. Malonic acid, e.g., is present in rather large amounts in green parts and seedlings of many *Papilionaceae*, but such an accumulation seems to be rare or totally lacking in *Caesalpinaceae* and *Mimosaceae*. It must be admitted, however, that acid metabolism of *Caesalpinaceae* is not well known. There are two exceptions to this statement. (+)-Tartaric acid and tartrates are stored in large amounts in leaves and fruits of *Tamarindus indica*, and the African *Bauhinia (Piliostigma) reticulata* produces (-)-tartaric acid which is accumulated as free acid and as tartrates in leaves and fruits. Tartaric acid is also present in appreciable amounts in leaves of *Bauhinia (Piliostigma) malabarica*, and was isolated from leaves of *Senna obtusifolia* (Matsuura et al. 1978). For chelidonic acid see sub turgorins of nyc-tinastic plants.

Gummi arabicum-type mucilages — A number of woody legumes shows the phenomenon known as gummosis, that is, they exude plenty of acidic mucilages after stress (e.g. traumata caused by animals, man, wind and extreme drought). This phenomenon was best studied with mimosoids which yield a number of economically important gum exudates, such as 'Gummi arabicum' (see p. 18 of the *Mimosaceae*-treatment). These acidic gum exudates contain taxon-characteristic amounts of proteins; in fact they are proteoglycans of glycoproteins. Compared with mimosoids, caesalpinoids are rather poor producers of gum exudates. Moreover, their gum exudates differ chemically in several respects from those of most hitherto investigated mimosoid traumatogenic mucilages. Analytical data are available for gum exudates of *Brachystegia glaucescens* and *B. spiciformis*, *Caesalpinia eriostachya* and two other American *Caesalpinia*-taxa, *Cassia grandis* and *Senna nicaraguensis*, *Cercidium praecox* and *Julbernardia globiflora*. Protein contents of these gums varied between 0.8 and 10.6%, and the composition of the protein component of these exudates was variable; depending on the taxon glycine, lysine, serine, threonine, proline and/or hydroxyproline were among the predominant amino acids generated on protein hydrolysis. The heteropolysaccharide component of caesalpinoid gum exudates is also rather variable. 4-O-Methylglucuronic acid, glucuronic acid, galacturonic acid, galactose, rhamnose, arabinose and/or xylose are present in highly variable proportions as building stones of these polysaccharides. However, the number of caesalpinoid species which have carefully analysed gum exudates is too

small for taxonomic purposes. Acidic mucilages are also deposited in certain cells of the epidermata of leaves and stems by many leguminous taxa. The distribution of such mucilages was studied by Solereder and his associates by making use of anatomical techniques. Chemical analyses of such leaf mucilage are scarce. Leaves of *Senna alexandrina* (= *Cassia angustifolia*) were shown to yield 2.5% (dry weight) of crude mucilage containing nearly equimolecular proportion (c. 20 mole % each) of galacturonic acid, rhamnose and galactose and about 30 mole % arabinose, 5 mole % glucose and a little mannose (Müller et al. 1989).

Flavonoids — Flavonoid metabolism of legumes was recently discussed by Hegnauer & Grayer-Barkmeijer (1993); see also pp. 19–20 of the *Mimosaceae*-treatment. Flavonols and flavones with the most usual hydroxylation patterns (3,5,7,3',4' and 5,7,3',4') are common in all three legume families. They usually occur as glycosides and may have one to several of their hydroxyls methylated. Myricetin-type flavonols (trihydroxylated B-ring) occur in all three families, but are perhaps somewhat more frequent in caesalpinioids than in the other two main taxa. Additional hydroxyls in position 6, 8 and 2' are by no means rare; such highly hydroxylated flavonoids are known from all three legume families. The most characteristic legume flavonoids are isoflavonoids in the wide sense, prenylated flavonoids and 5-deoxyflavonoids. These three types are mainly, but not totally, restricted to *Papilionaceae*. Examples of their occurrence in *Caesalpiniaceae* are the isoflavonoid pterocarpin leiocarpin from the bark of *Apuleia leiocarpa* (Braz Filho & Gottlieb 1971) and the assumedly isoprenylated torosa-flavone-C from leaves of *Cassia torosa* Cav. (Kitanaka et al. 1991). The last-mentioned name probably represents a form of *Senna sophora* (L.) Roxb.; the plant, probably of Chinese origin, was cultivated in the Medicinal Plant Garden of Nihon University. The isoprenylated anthraquinone from seeds of *Cassia marginata* auct. non Willd. (= *C. roxburghii* DC.) (Gupta et al. 1989) and the prenylated dihydrostilbene derivative racemosol from the heartwood of *Bauhinia racemosa* collected in the Paderu area of the Araku Valley (India) (Anjaneyulu et al. 1986) yielded an additional proof of the occurrence of prenylation of aromatic rings in *Caesalpiniaceae*. C-Methylation of flavonoids is known from *Senna* (*Cassia*) *occidentalis*; the 7-rhamnosides of two unusual aglyca, matteucinol (= 5,7-dihydroxy-4'-methoxy-6,8-dimethylflavanone) and jaceidin (= 5,7,4-trihydroxy-3,6,3'-trimethoxyflavone), were isolated from its leaves (Tiwari & Singh 1977). Synthesis of 5-deoxyflavonoids in *Caesalpiniaceae* is illustrated by *Bauhinia manca* (Achenbach et al. 1988) and *Cassia fistula* (Morimoto et al. 1988). Stems of *B. manca* yielded liquiritigenin and related chalcones and corresponding flavanones, such as isoliquiritigenin (= 7,4'-dihydroxyflavanone), and leaves of *C. fistula* contain dimeric flavanoids which have a 7,4'-dihydroxyflavan unit. Rotenoids are isoflavone derived isoflavonoids with a C₁₆-skeleton; they seem to be restricted in *Leguminosae* to a number of genera of *Papilionaceae*. Caesalpinioids and mimosoids produce flavon and flavanone analogues of rotenoids, the so-called peltogynoids (see p. 20 of the *Mimosaceae*-treatment). Peltogynoids occur in the caesalpinioid genera *Distemonanthus*, *Goniorrhachis* and *Peltogyne*. To complete this brief sketch of flavonoid profiles of *Caesalpiniaceae* it should be mentioned that leaves of *Bauhinia vahlii* yielded agathisflavon (= 6-8''-biapi-

genin) derivatives (Sultana et al. 1985) and that flavon-C-glycosides occur frequently in caesalpinoids. Occurrence of the latter may be illustrated by vitexin in leaves of *Senna* (*Cassia*) *occidentalis* (Anton & Duqu  nois 1968), the torosaflavones-A and -B and the 3'-glucoside of B in leaves of *Cassia torosa* (= *Senna sophera*, see above) (Kitanaka et al. 1989, 1992) and schaftoside and isoschaftoside and their 4'-glucosides in cotyledons of *Ceratonia siliqua* (Batista & Gomes 1993).

Stilbenoids and xanthones — Most of the naturally occurring stilbenoids (stilbenes, dihydrostilbenes [= dibenzyls], dihydrophenanthrenes) and xanthones (those hydroxylated in the 1- and 3-position) are biosynthetically intimately related with flavonoids. Xanthones of this type are rare in *Leguminosae* with the exception of mangiferin of the papilionoid genus *Hedy sarum*. Another such-like xanthone is the 4-rhamnoglucoside of 1,4,8-trihydroxy-3,7-dimethoxyxanthone which was isolated from the bark of *Cassia fistula* (Gupta et al. 1989). Stilbenoids, however, seem to occur frequently in woods; they were detected in members of *Caesalpinieae*, *Cassieae*, *Cercideae* and *Detarieae*, and are often present in appreciable amounts. The already mentioned *Bauhinia racemosa* and some species of *Cassia* s.l. will be used to illustrate stilbene metabolism of *Caesalpinieae*. A wood sample of *B. racemosa* collected in another site of the same Indian Valley yielded resveratrol and pacharin, a new dihydrostilbene derivative, instead of racemosol (Anjaneyulu et al. 1984). Several stilbene derivatives were isolated from woods of *Senna* (*Cassia*) *didymobotrya* (Delle Monache et al. 1991: O-methyl derivatives of 3,4,3',5' [= 3,5,3',4']-tetrahydroxystilbene), *S. dentata* (Oliveira et al. 1977: resveratrol and 3,4,3',5'-tetrahydroxystilbene), *Chamaecrista garrettiana* (Hata et al. 1979: 3,4,3',5'-tetrahydroxystilbene and the corresponding dihydrostilbene and dihydrophenanthrene and related stilbenoids; Baba et al. 1988, 1992: tetrahydroxystilbene dimers, the cassigarols A to D), *Cassia marginata* auct. (= *Cassia roxburghii*) (Rao & Rajadurai 1968: 3,4,3',5'-tetrahydroxystilbene), *Senna macranthera* (*Cassia pudibunda*) (Messana et al. 1991: 4-O-methyl-3,4,5,3',5'-pentahydroxystilbene from roots) and *Cassia roxburghii* (Ashok & Sarma 1987: roxburghin, a new tetrahydroxystilbene; N.B.: roxburghin is also the name given to a rubiaceous alkaloid). Other sources of tetra- and pentahydroxystilbenes are woods of *Vouacapoua americana* and *V. macropetala* (*Caesalpinieae*) and *Intsia bijuga*, *I. palembanica* and *Schotia brachypetala* (*Detarieae*). It should be mentioned that the 3,4,3',5' (= 3,5,3',4')-tetrahydroxystilbene is often called piceatannol in literature; this is an error, however, because this stilbene is different from Grassmann's piceatannol isolated from the soft bark of *Picea abies* (Grassmann & Endres 1965).

Tannins — Tannins were already discussed shortly in the *Mimosaceae*-treatment. They are widespread in *Leguminosae*, but largest amounts are present in roots, stems and fruits of woody plants of (sub)tropical regions. *Caesalpinieae* yielded tannin materials which were of economic importance formerly, i.e. the dried fruits of some South American and Indian *Caesalpinia* species: *Caesalpinia coriaria* yields 'Divi-divi', *C. brevifolia* yields 'Algar(r)obilla', *C. spinosa* yields 'Tara' or 'Guarango' and *C. digyna* yields the Indian crude drug 'Teri' or 'Tari' (Howes 1952; Stant 1972). All these tanning materials contain gallotannins, but in 'Divi-divi' and 'Algarobilla' ellagitannins predominate. It deserves mentioning that bergenin and several of its derivatives have

been isolated from different parts of caesalpinoid taxa: roots of *Caesalpinia digyna* and *Wagatea spicata*, flowers of *Peltophorum pterocarpum*, wood and bark of *Peltophorum africanum*. 'Avram bark', derived from *Cassia auriculata*, is another commercially available caesalpinoid tanning material; it contains condensed tannins which have not yet been studied in detail.

Non-protein(ogenic) amino acids — One of the striking phytochemical characters of many leguminous taxa is storage of large amounts of free amino acids, chiefly in seeds, but sometimes also in leaves and stems. These amino acids may be common proteinogenic acids. More often such storage products are more or less toxic non-protein amino acids, such as canavanine (restricted to some papilionoid tribes) and mimosine (occurring mainly in some *Mimosaceae*). The profiles of such amino acids are often taxonomically useful at generic and/or tribal levels. Some examples were chosen to illustrate this fact for a number of caesalpinoid genera. All members of the small genus *Griffonia* (= *Bandeirea*), i.e. *G. simplicifolia*, *physocarpa* and *G. speciosa*, store large amounts of 5-hydroxytryptophan in their seeds which are therefore very toxic to many insects (Bell et al. 1976). Shewry & Fowden (1976) investigated seeds of four African genera of *Amherstieae*. *Julbernardia globiflora* and *J. paniculata* had an amino acid profile dominated by γ -methylene glutamic acid and a 4,5-*trans*-isomer of 4,5-dihydroxypipelicolic acid; *Cryptosepalum exfoliatum* and *C. maraviense* had γ -methylene glutamic acid and γ -methylene glutamine as main amino acids; in seeds of *Isoberlinia angolensis* and *I. tomentosa* only pipelicolic, *trans*-5-hydroxypipelicolic and another *trans*-isomer of 4,5-dihydroxypipelicolic acids were observed; seeds of 7 species and one hybrid of *Brachystegia* had pipelicolic and *trans*-5-hydroxypipelicolic acids as main free amino acids; some of them also contained minor to medium amounts of *trans*-4-hydroxypipelicolic acid and of one dihydroxypipelicolic acid, and all contained additionally some γ -methylene glutamic acid. Remarkable observations were made with three African and a Ceylonese species of *Dialium* (Peiris & Senewiratne 1977): seeds of all four species were shown to contain over 2% of albizziine, an amino acid hitherto only known from *Mimosaceae*. Evans & Bell (1978) published a survey of profiles of free amino acids in seeds of *Caesalpinieae*; perhaps the most striking result was the demonstration of azetidine-2-carboxylic acid and 3-hydroxyproline as predominant free amino acids in seeds of all three species of *Bussea*, *B. gossweileri*, *B. massaiensis* and *B. occidentalis*. It is perhaps adequate to mention at this point a biosynthetically still mysterious group of non-cyanogenic cyanoglucosides having a cyclohexane or cyclohex-2-ene ring bearing a cyanomethylene substituent in 1-position and two to four hydroxyls in positions 4, 5 and 6, and sometimes 2. Such a glucoside was isolated in 1955 from roots of *Lithospermum purpureocoeruleum* (= *Buglossoides purpureocoeruleum*, *Boraginaceae*) and called lithospermoside when its structure was elucidated in 1977 by Sosa et al. The same glucoside was isolated by Plouvier from leaves and bark of *Cercis siliquastrum* during his cyclitol research and identified with lithospermoside in 1978. In the meantime Dwuma-Badu et al. (1976) had isolated besides 5-hydroxytryptophan a similar nitrile glucoside, griffonin, and its modified aglycone, griffonolide, from roots of *Griffonia simplicifolia*. Griffonin was later identified with lithospermoside. The 4-methylether of lithospermo-

side, called bauhinin, was isolated from roots of *Bauhinia championii* from Taiwan (Chen et al. 1985), and bark of *Bauhinia (Piliostigma) thonningii* from Nigeria yielded griffonolide (Okwute et al. 1986). Lithospermoside-type non-cyanogenic cyano-compounds occur erratically in dicotyledonous plants; they are also known from *Aquifoliaceae*, *Lauraceae*, *Menispermaceae*, *Ochnaceae*, *Ranunculaceae*, and *Simmondsiaceae*. For discussions of structures and stereochemistry of lithospermoside-type glucosides and their modified aglyca, see Yogo et al. (1990) and Murakami et al. (1993). As far as is known at present this type of glucosides is restricted in *Leguminosae* to the tribe *Cercideae* (*Bauhinia* p.p., *Cercis* p.p.) and is by no means ubiquitous in the taxa mentioned. Plouvier (1978) failed to trace lithospermoside in leaves and barks of *Bauhinia aurea*, *B. purpurea*, *Cercis canadensis* and *C. chinensis*.

Alkaloids — See also p. 21–22 of the *Mimosaceae*-treatment. True alkaloids are rather rare in *Caesalpiniaceae* with the exception of *Cynometra* and perhaps *Senna*. Four West African species of *Cynometra*, *C. ananta*, *C. hankei*, *C. lujae* and *C. mannii*, were investigated for the presence of alkaloids; histamine-derived alkaloids, such as anantine and cynometrine, are present in the first-mentioned three species, but seem to be lacking in *C. mannii* (Waterman & Faulkner 1981; Tchissambou et al. 1982). Several species of *Cassia* are mentioned in literature as producing 2,6-dialkylsubstituted piperidine alkaloids of the type already mentioned for *Prosopis* sub *Mimosaceae*. Accurate inspection of the data published shows that all taxa investigated belong to varieties of a single species, *Senna spectabilis*; about 8, probably acetogenic, piperidine alkaloids, have been isolated from these taxa (Struntz & Findlay 1985). The isoquinolone alkaloids siamine and siaminine A and B from seeds and leaves of *Senna (Cassia) siamea* probably also represent acetogenins (El-Sayyad 1984); the same holds for the chromone alkaloid cascadinine isolated from its flowers (Biswas & Malik 1986); from a biogenetic point of view all four compounds can be considered to be basic penta- to heptaketides. Leaves of *Senna septemtrionalis* (= *Cassia floribunda*) yielded 0.36% of N,N-dibenzoylspermidine (Alemayehu et al. 1988). We cannot leave caesalpinoid alkaloids without mentioning two different types of basic terpenoids. *Chamaecrista (Cassia) absus* yielded long ago chaksine; its structure was revised recently (Voelter et al. 1985) to a dimeric, macrocyclic monoterpene dilactone combined with two mols of guanidine. All species of *Erythrophleum* seem to produce basic cassane-type diterpenes which are known as Erythrophleum alkaloids and represent the toxic constituents of this genus (Collins et al. 1990). The claim that seeds, flowers and bark of *Senna (Cassia) auriculata* contain nephrotoxic pyrrolizidine alkaloids is in need of confirmation, because the analytical methods used (Arseculeratne et al. 1981) are somewhat questionable.

Diterpenes and balsams (= *oleoresins*) — ‘Balsam copaiba’ is the best known oleoresin produced by caesalpinoid taxa (Guenther 1952); it is deposited in excretory canals and cavities, which are rather common in stems, leaves and fruits of a number of *Detarieae*. True ‘balsam copaiba’ is produced by members of the South American genus *Copaifera* and consists of a mixture of mainly acidic diterpenes and volatile sesquiterpenes. ‘Copals’ are solidified oleoresins of conifers and legumes of the tribe *Detarieae*. This process of solidification involves evaporation of volatile mono- and sesquiterpenes and

polymerisations of unsaturated diterpenoids. Diterpenes, however, are by no means restricted to excretory cavities in *Leguminosae*. They may be deposited everywhere in a plant, e.g. roots, stems, leaves, seeds. 'Illurin balsam' or 'African copaiba balsam' and 'African copals' are produced by species of *Daniellia*, *Detarium*, *Gossweilerodendron*, *Oxystigma*, *Trachylobium*, and other *Detarieae*. The Indian *Kingiodendron pinnatum* (= *Hardwickia pinnata*) yields a similar balsam which is also used medicinally and technically [Wealth of India 5 (1959) 319]. Woods of South American species of *Eperua* yield similar oleoresins consisting of volatile sesquiterpenes and non-volatile diterpene acids. The two genera *Copaifera* and *Hymenaea* have large excretory cavities in leaves and pods besides their excretory canals in stems; their volatile leaf contents are chemically similar and consist mainly of caryophyllene-, copaene-, humulene- and selinene-type sesquiterpenic hydrocarbons; selection pressures seem to govern the composition of the volatile part of leaf oleoresins of individual populations and species (Langenheim 1981; Arrhenius & Langenheim 1983; Arrhenius et al. 1983). The chemistry of the acidic and neutral diterpenoids of *Detarieae* varies widely. This is exemplified by bicyclic labdane-type diterpenoids, such as copalic, daniellic and eperuic acids, bicyclic clerodane-type diterpenoids such as hardwickiic, kolavic, kolavenic and kolavenolic acids, tetracyclic kaurenic acids and pentacyclic trachylobanic acid. Often different parts seem to produce their own chemical oleoresin profiles. This has been shown for stem exudates, leaf pocket and seed pod oleoresins of *Trachylobium verrucosum* and several *Hymenaea* taxa (Khoo et al. 1973). Labdane- and clerodane-type diterpenes seem to be most characteristic of *Leguminosae*. Caesalpinoids also yielded rearranged labdanes (methyl migration from 10- to 9-position) (Khoo et al. 1973) and 2,3-secomanoyl oxide derivatives, such as colensenone and colensanone from leaves of *Senna* (*Cassia*) *petersiana* (Msonthi 1984). For cassane-type diterpenes which seem to be relatively characteristic of *Caesalpinaceae* see the *Mimosaceae*-treatment. Recent additions to cassane-chemistry are the chamaetexanins from roots of *Chamaecrista flexuosa* var. *texana* (= *Cassia texana*) (Barba et al. 1992).

Triterpenes and saponins — These classes of constituents are of rather common occurrence in leguminous plants. They were considered in some detail in the *Mimosaceae*-treatment. Free triterpenes are deposited probably in caesalpinoids as frequently in woods and barks as in the two other (sub)families. As an example the isolation of lupeol, luponone and betulinic acid from bark of *Melanoxylon brauna* may be mentioned (Gottlieb et al. 1971). Saponins seem to be stored in large quantities less frequently by caesalpinoids than by mimosoids and papilionoids. This difference, however, may be rather artificial, because caesalpinoids were less intensely studied for saponins. Available evidence suggests that oleanene-type triterpenic acids are main sapogenins in *Caesalpinaceae*: oleanolic acid (*Mora gongrijpii*), morolic acid (*Mora excelsa*), echinocystic acid (*Gleditsia fera* Merr., *G. chinensis* Lam., *G. japonica* Miq., *G. triacanthos* L.) and 2 β ,23-dihydroxyacacic acid [*Gymnocladus dioica* (L.) Koch and *G. chinensis* Baill.]. Konoshima et al. (1981) described two chemodemes of *Gleditsia japonica* in Japan: one has practically saponin-free pods and the other, called chemodeme 'Saponifera' produces pods used medicinally and containing large amounts of mono-, bis- and trisdesmosidic

saponins. Such intraspecific chemical variability in secondary constituents is perhaps more common in *Leguminosae* than is usually assumed. The *Gleditsia* and *Gymnocladus* saponins have highly complex structures; their sugar parts are acylated by one to several molecules of hydroxymonoterpenic acids; in this respect these saponins are similar to the *Entada* saponins mentioned in the *Mimosaceae*-treatment.

Other secondary compounds of taxonomic significance — Many other types of secondary metabolites occur erratically. A few caesalpinoids were reported to be weakly cyanogenic, but hitherto no cyanogenic compounds have been isolated from members of this taxon. One biogenetic class, the chrysophanol-rhein-type anthraquinones, deserves special attention. Such quinonoid constituents are responsible for many biological properties and medicinal and technical uses of the respective taxa; moreover they yield valuable taxonomic characters. Biogenetically chrysophanol-type anthraquinones are acetogenins (= polyketides); in fact they are octaketides and probably occur in every species of *Cassia* s.l. with many species-specific chemical profiles and localization patterns (roots, bark, wood, leaves, flowers, pods, seeds, seedlings). In *Senna* species these anthraquinones are accompanied by biogenetically related octaketides of non-quinonoid nature, such as the xanthenes pinselin (e.g., *S. occidentalis*) and cassiaxanthone (*S. reticulata*), the tetrahydroanthracenes like torosachryson (e.g., *Cassia torosa* Cav. = *Senna sophora*) and germichryson (e.g., *S. occidentalis*). Often these octaketides are also accompanied by heptaketides, such as tinnevellin-8-glucoside (*S. angustifolia*), torachryson (*S. tora*), rubrofusarin and nor-rubrofusarin (e.g., seeds of *S. tora*). The structures of the already mentioned basic constituents of *S. siamea*, siamine and the siaminines, suggest a pentaketide origin. Octaketidic anthraquinones were also isolated from wood and bark of *Melanoxylon brauna* (Gottlieb et al. 1971).

Phytoalexin-production has not yet been traced in *Caesalpinaceae*.

Nyctinastins (= *nyctinastenes* = *turgorins*) — The chemistry of nastic leaf movements was already briefly discussed in the *Mimosaceae*-treatment. Many caesalpinoids also show periodical movements of folioli. Nastic movements are caused by turgor-changes in cells of the so-called pulvini (at base of petioles) and pulvinuli (at base of folioli). These turgor-changes are triggered by phytohormone-like chemicals. Japanese workers investigated *Chamaecrista* (*Cassia*) *mimosoides*, *Senna* (*Cassia*) *occidentalis* and *S. (Cassia)* *tora* and other leguminous taxa and found two factors which they believe to be specific turgorins of the *Cassieae*: potassium chelidonate was shown to be a leaflet-closing factor and potassium lespedezate and potassium isolespedezate (isolated from the papilionoid plant *Lespedeza cuneata*) were shown to be specific leaflet-opening factors for all three species belonging to the *Cassieae* tested by them (Miyoshi et al. 1987; Shigemori et al. 1989, 1990). It is worth mentioning that chelidonic acid and its mono- and dimethyl esters are present in large amounts in flowers of *Senna (Cassia) spectabilis* and were shown to have antiallergic and weak antifeedant properties (Veera Mallaiiah et al. 1980, 1984; Ashok & Sarma 1988).

Nodulation and symbiotic nitrogen-fixation — See also the *Mimosaceae*-treatment for references. N_2 -Fixation is a key character of *Leguminosae*. It is connected with root-nodulation (seldom stem-nodulation) and symbiosis with different strains of *Rhizobia*.

In *Caesalpinaceae* nodulation seems to be restricted mainly to *Caesalpinieae* p.p. and *Cassieae* p.p. and to be extremely rare in *Cercideae*, *Detarieae* and *Amherstieae*. Apparently many tropical woody legumes prefer symbiotic associations with fungi (mycorrhiza) to symbiosis with bacteria of the family *Rhizobiaceae*.

Summary — Summarizing the following statements seem to be appropriate:

a) In chemical respects *Caesalpinaceae* are typical members of *Leguminosae*. As arguments their seed galactomannans, their seed sugars belonging to the raffinose series, production and accumulation of pinitol and related cyclitols, their proanthocyanidins, peltogynoid-type flavonoids with a C₁₆-skeleton and their stilbenes, and the production and storage of non-protein amino acids in many of their taxa can be quoted.

b) Moreover, synthesis and accumulation of compounds of several classes of secondary metabolites yield characters which are taxonomically useful at the tribal and/or generic levels. In this respect saponins, oleoresins and the polyketide metabolites of *Cassia* s.l. deserve special attention.

c) Metabolic features which are characteristic of *Caesalpinaceae* as a whole have not been traced hitherto, as far as I am aware.

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TAXONOMY

The fundamental works on the *Leguminosae* are those of Bentham (1865) and Taubert (1894). Taubert divided the family into three subfamilies but commented that there are no sharp limits between them. Following Bentham he divided the *Caesalpinioideae* into eight tribes, again stating that this is in many ways an artificial division and that it is difficult to delimit the tribes as there are several transitional groups. Hutchinson (1964) divided *Caesalpinieae* into two subfamilies: *Caesalpinioideae* with small and often early caducous bracteoles (or if bracteoles larger then mostly petaloid) and *Brachystegioideae* with large, usually persistent bracteoles. Also in this system difficulties arise in placing several genera.

Later Cowan (1981) recognized five tribes within the *Caesalpinioideae*: *Cercideae*, *Caesalpinieae*, *Cassieae*, *Detarieae* and *Amherstieae*.

Recently Breteler (1995) studied the demarcation of *Amherstieae* and *Detarieae* and concluded that they should be united as one tribe under the name of *Detarieae*. He also added a new tribe, i.e. *Macrolobieae*.

The important characters for the recently delimited tribes and their Malesian genera (including introduced or cultivated ones) are listed below. For more details see Cowan (1981) and Breteler (1995).

- 1) *Cercideae* Bronn — Many characters indicate that this probably is the most primitive tribe or, as Cowan (1981) suggests, an early offshoot of the *Caesalpinioideae*. The leaves are simple, bilobed or consisting of two free leaflets, palmately veined. A group of only 5 genera; in Malesia *Bauhinia* is the sole genus.
- 2) *Caesalpinieae* Polhill & Vidal — Stipules lateral or absent. Leaves are generally compound or, if consisting of a sole foliole, then pinnately veined. Hypanthium most often tubular or cupular. Stipules lateral or absent; bracteoles small or absent. The following Malesian genera belong here: *Acrocarpus*, *Caesalpinia*, *Gleditsia*, *Pelthophorum*, *Pterolobium*, *Sympetalandra*, and *Delonix* (introduced).
- 3) *Cassieae* Bronn — Stipules lateral. Hypanthium absent or short and filled with secretory tissue. In Malesia the following genera occur: *Cassia*, *Chamaecrista*, *Dialium*, *Kalappia*, *Koompassia*, *Senna*, and *Uittienia*.
- 4) *Detarieae* DC., following the redelimitation by Breteler (1995) — Bracteoles not always present and never protecting the flower bud till anthesis. The calyx always well developed. The following genera occur in Malesia: *Afzelia*, *Amherstia*, *Brownea*,

Copaifera, *Crudia*, *Cynometra*, *Enderbia*, *Hymenaea*, *Intsia*, *Kingiodendron*, *Leucostegane*, *Maniltoa*, *Saraca*, *Sindora* and *Tamarindus*.

- 5) *Macrobolieae* Breteler — Important characters as published in the original description: Bracteoles valvate, often thick, covering the flower bud till anthesis, resembling a calyx, often persistent. Calyx usually reduced. Distributed in African and American tropics. No representative genera cultivated in Malasia.

Literature: Benthams, G., Leguminosae—Eucaesalpinioideae., in: G. Benthams & J.D. Hooker, *Genera Plantarum* 1 (1865) 458–459, 565–570. — Breteler, F.J., The boundary between Amherstiaeae and Detarieae (Caesalp.), in: M. Crisp & J.J. Doyle (eds.), *Adv. Leg. Syst.* 7 (1995) 53–61. — Cowan, R.S., Caesalpinioideae. in: R.M. Polhill & P.H. Raven (eds.), *Adv. Leg. Syst.* 1 (1981) 57–64. — Hutchinson, J., The genera of flowering plants 1 (1964) 230–276. — Schulze-Menz, G.K., Leguminosae—Caesalpinioideae, in: Engler’s *Syllabus Pflanzenfamilien*, ed. 12, 2 (1964) 226–230. — Taubert, P., Leguminosae, in: A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* 3, 3 (1894) 70–396. — Watson, L., An automated system of generic descriptions for Caesalpinioideae, and its application to classification and key-making, in: R.M. Polhill & P.H. Raven (eds.), *op. cit.* (1981) 65–80. — Watson, L. & M.J. Dallwitz, The genera of Leguminosae—Caesalpinioideae: anatomy, morphology, classification and keys (1983) 95 pp.

KEY 1 TO THE GENERA

(Based on fertile specimens)¹

- 1a. Leaves simple, usually more or less bilobed, sometimes deeply divided (seemingly bifoliolate). Venation palmate (or fan-like), or parallel **Bauhinia** (p. 442)
- b. Leaves compound, rarely unifoliolate (or seemingly a simple leaf). Venation neither palmate (or fan-like) nor parallel 2
- 2a. Leaves bipinnate 3
- b. Leaves simple pinnate, rarely unifoliolate 11
- 3a. Plants armed with prickles, spines or thorns 4
- b. Plants not armed 7
- 4a. Spines often branched, especially those on the trunks and branches. Flowers actinomorphic. Petals 3–5. Stamens 6–10 fertile **Gleditsia** (p. 619)
- b. Spines simple. Flowers slightly zygomorphic or bilateral. Stamens 10, all fertile 5
- 5a. Leaf-rachis very short, spine-like. Rachides of pinnae flattened, phyllodial. Leaflets tiny, numerous, caducous. Pods constricted externally between the seeds **Parkinsonia** (cult., p. 726)
- b. Leaf-rachis not spine-like. Rachides of pinnae neither flattened nor phyllodial. Leaflets several to many, small to large, not caducous. Pods not like above 6
- 6a. Floral parts often punctate. Calyx lobes and petals usually (markedly) zygomorphic. Stamens with glabrous filaments. Ovary 1–10(–13)-ovuled **Caesalpinia** (p. 535)
- b. Floral parts not punctate. Calyx lobes and petals slightly unequal. Stamens with filaments pilose at the base. Ovary 2- or 3-ovuled . . . **Haematoxylum** (cult., p. 723)

¹) N.B.: See also the Key to the Exotic Genera on page 716.

- 7a. Petals 3–7 cm long, with long claw **Delonix** (cult., p. 721)
 b. Petals 0.25–2.5 cm long 8
- 8a. Stamens 5 **Acrocarpus** (p. 435)
 b. Stamens 10 9
- 9a. Leaflets (1 or) 2 (3–6) pairs per pinna. Petals small, 2.5–5 mm long. Stamens with glabrous filaments. Pods dehiscent in two valves ... **Sympetalandra** (p. 709)
 b. Leaflets often more pairs (4–27) per pinna. Petals much larger, 12–25 mm long. Stamens with filaments pilose or villous at the base or basal part. Pods indehiscent or dehiscing at the apex only 10
- 10a. Petals distinctly clawed, the claw 4–7 mm long. Pods dehiscing at the apex
 **Schizolobium** (cult., p. 728)
 b. Petals not clawed. Pods indehiscent **Peltophorum** (p. 650)
- 11a. Leaves imparipinnate 12
 b. Leaves paripinnate 18
- 12a. Petals 5. Pods winged 13
 b. Petals absent, or greatly reduced (*Dialium*). Pods not winged 14
- 13a. Stamens 5. Ovary 1-ovuled. Pods surrounded by a broad, papery wing
 **Koompassia** (p. 631)
 b. Stamens 7–9 (4 or 5 fertile, 2–4 staminodes). Ovary 3–5-ovuled. Pods with a narrow wing along one suture **Kalappia** (p. 625)
- 14a. Calyx lobes or sepals 4. Pods dehiscent, 1–4(–6)-seeded 15
 b. Calyx lobes or sepals usually 5. Pods indehiscent, 1-seeded 16
- 15a. Inflorescences racemose. Ovary 1–6-ovuled. Pods 1–4(–6)-seeded. Seeds exarillate **Crudia** (p. 573)
 b. Inflorescences paniculate. Ovary 2-ovuled. Pods 1- or 2-seeded. Seeds arillate ..
 **Copaifera** (p. 570)
- 16a. Fertile stamens 10. Ovary 1-ovuled. Pods often flattened. Cotyledons strongly folded (seen in section) **Kingiodendron** (p. 627)
 b. Fertile stamens usually 2. Ovary 2-ovuled. Pods often globose. Cotyledons not folded 17
- 17a. Pods with a thin crustaceous, usually hairy exocarp, easily crushed or sometimes detached from mesocarp **Dialium** (p. 608)
 b. Pods with a crustaceous, glabrous exocarp, united with a thick (c. 4–5 mm) and hard mesocarp, uncrushable by hard press between two hands
 **Uittienia** (p. 714)
- 18a. Inflorescences short, compact, nodding capitate, peduncle and rachis together less than 5 cm long, densely flowered. Young leaves in pendent, linear, stipular or bracteate sheath buds (up to 20 cm long) **Brownea** (cult., p. 718)
 b. Inflorescences and young leaves not like above 19
- 19a. Bracteoles large, red, (4.5–)8–9 cm long, persistent **Amherstia** (cult., p. 717)
 b. Bracteoles small or minute, not red, less than 2.5 cm long, often caducous .. 20

- 20a. Petals absent **Saraca** (p. 660)
- b. Petals present, 1–5 21
- 21a. Only 1 petal developed, the others rudimentary or wanting 22
- b. Often 2–5 petals developed 24
- 22a. Calyx lobes often spiny outside. Fertile stamens often 10. Pods often spiny outside **Sindora** (p. 691)
- b. Calyx lobes smooth outside. Fertile stamens 3–8 23
- 23a. Stamens often (5–)7 fertile. Seeds arillate **Afzelia** (p. 438)
- b. Stamens often 3 fertile. Seeds not arillate **Intsia** (p. 622)
- 24a. Calyx lobes or sepals often 4. Pods indehiscent 25
- b. Calyx lobes or sepals usually 5. Pods dehiscent 28
- 25a. Petals often 2 or 3 developed, with or without reduced ones. Fertile stamens 3; filaments and staminodes connate about half their length into a pubescent tube **Tamarindus** (cult., p. 728)
- b. Fertile stamens 2 or 10, free or filaments and staminodes connate at the base into a glabrous, very short incomplete ring 26
- 26a. Fertile stamens 10, free **Hymenaea** (cult., p. 724)
- b. Fertile stamens 2, free, or filaments and staminodes connate at the base 27
- 27a. Stipules foliaceous, persistent. Stamens and staminodes free **Leucostegane** (p. 635)
- b. Stipules very small, caducous. Stamens and staminodes connate at the base **Endertia** (p. 616)
- 28a. Stamens 15–80; filaments often connate at the base **Maniltoa** (p. 638)
- b. Stamens (5–)10(–15); filaments free 29
- 29a. Anther-thecae dehiscing lengthwise 30
- b. Anther-thecae dehiscing by apical or basal pores or short slits 31
- 30a. Calyx and corolla pellucid-glandular. Pods rather big, up to 36(–67) cm long, dehiscent **Sympetalandra** (p. 709)
- b. Calyx and corolla not as above. Pods rather small, less than 6 cm long, indehiscent **Cynometra** (p. 597)
- 31a. Stamens 10, 3 abaxial ones with long filaments sigmoidally curved, the anthers dehiscing by short slits; remaining 7 with short and straight filaments, the anthers dehiscing by basal pores **Cassia** (p. 556)
- b. Stamens 10, 5–7 or all fertile; filaments straight, the anthers dehiscing by short slits or apical pores 32
- 32a. Anther-thecae ciliolate along the sutures. Pods elastically dehiscent; valves coiling **Chamaecrista** (p. 565)
- b. Anther-thecae glabrous. Pods either indehiscent or dehiscent through 1 or both sutures; valves not coiling **Senna** (p. 673)

KEY 2 TO THE GENERA
(Based on fruiting collections)¹

- 1a. Leaves simple, usually more or less bilobed, sometimes deeply divided (seemingly 2-foliolate). Venation palmate (or fan-like), or parallel **Bauhinia** (p. 442)
- b. Leaves compound, rarely unifoliolate (or seemingly a simple leaf). Venation neither palmate (or fan-like) nor parallel 2
- 2a. Leaves bipinnate 3
- b. Leaves simple pinnate, rarely unifoliolate 13
- 3a. Plants armed with prickles, spines or thorns 4
- b. Plants not armed 10
- 4a. Spines often branched, especially those on the trunks and branches **Gleditsia** (p. 619)
- b. Spines simple 5
- 5a. Leaf-rachis very short, spine-like. Rachides of pinnae flattened, phyllodial. Leaflets tiny, numerous, caducous. Pods constricted externally between the seeds **Parkinsonia** (cult., p. 726)
- b. Leaf-rachis not spine-like. Rachides of pinnae neither flattened nor phyllodial. Leaflets several to many, small to large, not caducous. Pods not like above 6
- 6a. Pods not winged 7
- b. Pods winged 9
- 7a. Pods dehiscent at the apex **Schizolobium** (cult., p. 728)
- b. Pods dehiscent along the sutures, two-valved, rarely indehiscent (part of *Caesalpinia*) 8
- 8a. Seeds transversely oblong **Haematoxylum** (cult., p. 723)
- b. Seeds often orbicular or globose, ellipsoid or reniform . . . **Caesalpinia** (p. 535)
- 9a. Pods samaroid, winged above the seed-bearing part **Pterolobium** (p. 654)
- b. Pods winged along one suture side **Caesalpinia** (p. 535)
- 10a. Pods indehiscent **Peltophorum** (p. 650)
- b. Pods dehiscent, 2-valved 11
- 11a. Pods narrowly winged along one suture, valves thin-coriaceous **Acrocarpus** (p. 435)
- b. Pods not winged, valves distinctly woody or coriaceous 12
- 12a. Leaflets (1 or) 2 (3–6) pairs per pinna. Pods 1–4-seeded; seeds large, 3–3.5 cm long **Sympetalandra** (p. 709)
- b. Leaflets 12–25(–40) pairs per pinna. Pods many-seeded; seeds smaller, up to 2.5 cm long **Delonix** (cult., p. 721)
- 13a. Leaves imparipinnate 14
- b. Leaves paripinnate 19

¹ N.B.: See also the Key to the Exotic Genera on page 716.

- 14a. Pods winged 15
- b. Pods not winged 16
- 15a. Pods surrounded by a broad, papery wing **Koompassia** (p. 631)
- b. Pods with a narrow wing along one suture **Kalappia** (p. 625)
- 16a. Pods dehiscent, 1–3-seeded **Crudia** (p. 573)
- b. Pods indehiscent, 1-seeded 17
- 17a. Pods often flattened. Cotyledons strongly folded (seen in section)
 **Kingiodendron** (p. 627)
- b. Pods often globose. Cotyledons solid, not folded 18
- 18a. Pods with a thin crustaceous, usually hairy exocarp, easily crushed or sometimes
 detached from mesocarp **Dialium** (p. 608)
- b. Pods with a crustaceous, glabrous exocarp united with a thick (4–5 mm) and hard
 mesocarp, uncrushable by hard press between two hands . . . **Uittienia** (p. 714)
- 19a. Young leaves in pendent, linear, stipular or bracteate sheath buds (up to 20 cm
 long) **Brownea** (cult., p. 718)
- b. Young leaves not like above 20
- 20a. Pods often spiny outside **Sindora** (p.p., p. 691)
- b. Pods not spiny outside 21
- 21a. Pods indehiscent 22
- b. Pods dehiscent 26
- 22a. Leaves each with 1 pair of leaflets, pellucid-punctate . **Hymenaea** (cult., p. 724)
- b. Leaves each with 2–many pairs of leaflets, not pellucid-punctate 23
- 23a. Young leaves in two ranks, scaly buds; leaflets asymmetric, midrib more towards
 the upper margin. Pods often 2–many-seeded 24
- b. Young leaves and leaflets not like above. Pods often 2–many-seeded 25
- 24a. Pods rugose, warty or smooth **Cynometra** (p. 597)
- b. Pods smooth **Maniltoa** (p. 638)
- 25a. Seeds endospermic **Cassia, Senna** (p.p., p. 556, 673)
- b. Seeds not endospermic **Tamarindus** (cult., p. 728)
- 26a. Stipules foliaceous, (5–)12.5–40 mm long 27
- b. Stipules minute 28
- 27a. Stipules persistent **Leucostegane** (p. 635)
- b. Stipules caducous **Amherstia** (cult., p. 717)
- 28a. Seeds arillate 29
- b. Seeds not arillate 30
- 29a. Aril often 2-lobed, covering the seed for up to half or more of its length
 **Afzelia** (p. 438)
- b. Aril irregularly shaped, covering only the base of the seed
 **Sindora** (p.p., p. 691)
- 30a. Seeds very small, usually 0.3–1 cm long 31
- b. Seeds much larger, 2–4.5 cm long 32

- 31a. Valves of pods coiling during dehiscence **Chamaecrista** (p. 565)
- b. Valves of pods not coiling during dehiscence **Senna** (p. 673)
- 32a. Valves of pods often straight or slightly twisting during dehiscence 33
- b. Valves of pods twisting and enrolling, or coiling 34
- 33a. Leaflets usually with 1 or 2 small crateriform glands at the basal part on lower surface. Valves of pods leathery or slightly woody **Intsia** (p. 622)
- b. Leaflets without the glands as above. Valves of pods distinctly woody
..... **Sympetalandra** (p. 709)
- 34a. Seeds 3–4 by 3 cm **Endertia** (p. 616)
- b. Seeds often smaller, 2–3 by 1.25–2 cm **Saraca** (p. 660)

SYNOPSIS OF SPOT CHARACTERS

Herbaceous with woody base: *Chamaecrista*, *Senna*

Leaves simple, usually more or less bilobed, sometimes deeply divided (seemingly bifoliate). Venation palmate (or fan-like), or parallel: *Bauhinia*

Young leaves in pendent, linear, stipular or bracteate sheath buds (up to 20 cm long): *Brownea* (cult.)

Leaves bifoliate. Leaflets and floral parts pellucid-punctate. Pods indehiscent: *Hymenaea* (cult.)

Leaf-stalks or axes of inflorescences sometimes bearing nectariferous glands: *Chamaecrista*, *Senna*

Leaflets sometimes with a pair of wart-like glands at the base and/or at the apex: *Saraca*

Leaflets usually with 1 or 2 small crateriform glands at the basal part on lower surface: *Intsia*

Leaflets opposite, asymmetric, the midrib usually excentric and close to the upper margin. Buds covered by 2-ranked, caducous bud-scales. Inflorescences axillary, sessile, globular, contracted: *Maniltoa*, *Cynometra* (p.p.)

Rachis of pinna elongate, flattened, phyllodial, ending in a spine, persistent. Leaflets tiny, numerous. Pods often constricted between the seeds: *Parkinsonia* (cult.)

Spines often branched: *Gleditsia*

Leaves bipinnate, armed: *Caesalpinia*, *Parkinsonia* (cult.), *Peltophorum*

Leaves bipinnate, unarmed: *Acrocarpus*, *Delonix* (cult.)

Inflorescences long, hanging racemose, loosely flowered. Flowers large, showy, red.

Petals 5.7–7 cm long: *Amherstia* (cult.)

Inflorescences short, compact, mostly nodding capitate, densely flowered: *Brownea* (cult.)

Calyx lobes often with spiny outgrowths on the outer surface: *Sindora*

Calyx and corolla pellucid-glandular: *Hymenaea*, *Sympetalandra*

Petals absent, or 1–5 petals greatly reduced: *Copaifera*, *Crudia*, *Dialium*, *Saraca*

Petals: only 1 developed, the others rudimentary or wanting: *Azelia*, *Intsia*, *Sindora*

Stamens many, 15–80; filaments often connate at the base: *Maniltoa*

Stamens: often only 2 fertile: *Dialium* (most spp.), *Enderertia*, *Leucostegane*

Stamens with filaments more or less equal in length; filaments pilose at the basal part:

Peltophorum

Anther-thecae dehiscent by apical or basal pores, or short slits: *Bauhinia* (p.p.), *Cassia*,

Chamaecrista, *Kalappia*, *Senna*

Anthers \pm hairy at apical and/or basical ends: *Saraca*, *Sympetalandra* (p.p.)

Pods often spiny: *Caesalpinia* (rarely), *Sindora*

Pods rather big, globose or subglobose, drupaceous, c. 6 cm in diam., with a roughish, somewhat scruffy-granular brown surface: *Uttienia*

Pods winged along both sutures: *Peltophorum*

Pods surrounded by a broad, papery wing: *Koompassia*

Pods winged along only one suture: *Caesalpinia*, *Kalappia*

Pods samaroid, with an oblique or falcate wing above the seed bearing part: *Pterolobium*

Pods dehiscent at the apex only: *Schizolobium* (cult.)

Pods indehiscent, drupe-like: *Dialium*

Seeds with strongly folded cotyledons (easily seen in section). Slashed wood usually exuding a green sap (see field note): *Kingiodendron*

ACROCARPUS

(Ding Hou)

Acrocarpus Wight ex Arnott, Mag. Zool. Bot. 2 (1838) 547; Polhill & Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 88; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 7; Ding Hou, Blumea 38 (1994) 314. — Type species: *Acrocarpus fraxinifolius* Arnott.

Trees. *Stipules* small, caducous. *Leaves* spiral, impari- or paribipinnate. *Leaflets* petiolulate. *Inflorescences* axillary, solitary, sometimes few-branched, branches with spike-like racemes, erect, bottle-brush-like; bracts and bracteoles small, caducous. *Flowers* bisexual, pedicelled. *Hypanthium* cupular. *Calyx* lobes 5, imbricate. *Petals* 5, imbricate. *Disk* cupular, completely united with the hypanthium. *Stamens* 5; anthers versatile, introrse. *Ovary* with a free stipe, oblong or linear, 10–20-ovuled; style and stigma not sharply distinct from the ovary, incurved, pointed at the apex. *Pods* erect, elongate, flattened, long-stipitate, narrowly winged along the adaxial suture, 2-valved; valves straight, thin-coriaceous, (3–)10–18-seeded. *Seeds* slightly lens-shaped, smooth, not albuminous.

Distribution — So far known only one species in eastern India, Burma, Thailand, Laos, China, and *Malesia*.

Habitat — Forest, altitude 600–1200 m.



Fig. 1. *Acrocarpus fraxinifolius* Arnott. Habit. Photograph of a water-colour drawn by A. Bernecker in March 1863. Original plate in Leiden, nat. size; photograph B. Kieft, $\times 0.27$.

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Fig. 2. *Acrocarpus fraxinifolius* Arnott. a. Habit; b. leaf; c. secondary petiole with basal pair of leaflets; d. flower; e. part of infructescence; f. opened pod; g. tree form, diagrammatic. Reproduced from Koorders, Atlas 1: f. 12.



Acrocarpus fraxinifolius Arnott

Acrocarpus fraxinifolius Arnott, Mag. Zool. Bot. 2 (1838) 547; Ding Hou, Blumea 38 (1994) 315. — Type: Wight 2466 (K holo; GH, L), India.

Mezoneurum grande Miq., Sumatra 1 (1860) 108, nom. nud.; 2 (1861) 291. — *Acrocarpus grandis* (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 87. — Types (Ding Hou 1994): *Teijsmann HB* 887 (U hololecto), *Teijsmann HB* 862 (U syn), W Sumatra.

Acrocarpus combretiflorus Teijsm. & Binnend., Nat. Tijd. Ned. Indië 29 (1866) 258, nom. illeg.; Cat. Hort. Bogor. (1866) 269. — Syntype: *Teijsmann s.n.* (L iso), W Sumatra.

Tree 20–30(–50) m high and 0.6–1(–4) m in diam. *Leaves* rather large, petiole and main rachis up to 80 cm; pinnae (2–)3–5 pairs, secondary petiole and rachis up to c. 45 cm long. *Leaflets* 4–7(–9) pairs per pinnule, chartaceous, ovate or ovate-oblong, 3.5–11 (–18) by 1.5–5(–8.5) cm, shortly acuminate or acute; base cuneate, obtuse, or rotund, rarely obscurely cordate, sometimes slightly asymmetric; pubescent beneath when young, glabrescent, often slightly hairy along the midrib and on the petiolules, sometimes almost glabrous when old; lateral nerves 5–9(–12) pairs; petiolules 2–4 mm. *Inflorescences* up to 32 cm long; pedicels 4–10 mm. *Hypanthium* 2.5–8 mm long. *Calyx* puberulous outside; lobes ovate or triangular, 2.5–4 mm long. *Petals* dark red, oblong or slightly oblanceolate, 5–9 by 1–2.5 mm, puberulous on both surfaces. *Disk* hairy on the lower half inside. *Stamens*: filaments 15–18 mm; anthers 2–3 mm long. *Ovary* 12–15 mm long, loosely hairy except the apical part. *Pods* (8–)10–12(–17) by (1–)1.5–2 cm (incl. stipe); wing 3–5 mm wide, rather smooth. *Seeds* c. 6.5 by 5 mm. — **Fig. 1, 2.**

Distribution — See under the genus. In *Malesia*: Sumatra and C Java.

Habitat & Ecology — In constantly wet and fertile soil in the forest, sometimes found in abandoned fields, altitude 600–1200 m. Fl. Feb., Mar., May, Dec.; fr. Mar., April, Sept.–Nov.

AFZELIA

(Ding Hou)

Afzelia J.E. Smith, Trans. Linn. Soc. 4 (1798) 221, nom. cons., non J.E. Gmelin, 1791 [= *Seymeria* Pursh., *Scrophulariaceae*]; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 7; Ding Hou, Blumea 38 (1994) 316. — Type species: *Afzelia africana* J.E. Smith ex Pers.

Pahudia Miq., Fl. Ind. Bat. 1, 1 (1855) 85. — Type species: *Pahudia javanica* Miq. [= *Afzelia javanica* (Miq.) Léonard].

Trees. *Stipules* interpetiolarly connate at base. *Leaves* paripinnate. *Leaflets* chartaceous, shortly petiolulate, petiolule often turned or twisted. *Inflorescences* terminal or axillary, racemose, often fasciculate or paniculate; bracts and bracteoles small, often caducous. *Flowers* bisexual, zygomorphic, pedicelled. *Hypanthium* cupular, narrowly infundibuliform or cylindric, puberulous outside, glabrous inside. *Calyx* lobes 4, imbricate, puberulous on both surfaces. *Petals* only one fully developed, large, flabellate, lower half narrowed into a claw, the others small or absent. *Disk* absent. *Stamens* 9, usually (5–)7 fertile, almost equal, the others reduced; anthers dorsifixed. *Ovary* stipitate (stipe adnate to the hypanthium), 3–8(or more)-ovuled; style slender, almost as long as the stamens; stigma small, round. *Pods* oblong, obliquely oblong, or slightly

rhomboid, compressed, black when ripe, glabrous, 2-valved, valves thick, woody, often 3 (or more)-seeded. *Seeds* ellipsoid, ovoid-oblong or broadly ellipsoid, smooth, exalbuminous; aril yellow, orange, or red, often 2-lobed, covering the seed for up to half or more of its length.

Distribution — About 12 species, in tropical Africa, Asia and S China; 2 species in *Malesia*.

Habitat — In forest at low and medium altitudes, 0–400(–1400) m.

Uses — The timber of *Afzelia* species is highly valued. See Phengklai et al. in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 69.

Note — Tetrad pollen, occurring sporadically in the family, was also reported for two (non-Malesian) species of *Afzelia* [Ferguson & Banks, Rev. Palaeobot. Palyn. 83 (1994) 31–42].

KEY TO THE SPECIES

- 1a. Leaves usually pubescent, sometimes densely pubescent on the petiole, rachis, petiolules, and especially on the midrib of the lower surface of leaflets. Petals not papillate. Filaments united along the lower (1.5–)2–2.5 cm **1. *A. javanica***
- b. Leaves often glabrous, sometimes sparsely (very rarely densely) pubescent on the petiole, rachis, petiolules, and especially on the midrib of the lower surface of leaflets. Petals often papillate at least on the inner surface. Filaments united at the base (or almost free) **2. *A. rhomboidea***

1. *Afzelia javanica* (Miq.) Léonard

Afzelia javanica (Miq.) Léonard, Reinwardtia 1 (1950) 63; Ding Hou, Blumea 38 (1994) 317. — *Pahudia javanica* Miq., Fl. Ind. Bat. 1, 1 (1855) 86. — *Pahudia javanica* subsp. *javanica*; Backer & Bakh. f., Fl. Java 1 (1964) 530. — *Pahudia javanica* subsp. *eujavanica* de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1941) 146, f. 2: 1. — *Afzelia javanica* subsp. *javanica*; Léonard, Reinwardtia 1 (1950) 63. — Type: Horsfield 'L 147' (K holo; BM, photo of both types in L), C Java.

Intsia puberula Miq., Sumatra 1 (1860) 107, nom. nud.; 2 (1861) 290. — *Pahudia puberula* (Miq.) Meijer Drees, Bull. Jard. Bot. Buitenzorg III, 16 (1938) 97; de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1941) 145. — Type: Diepenhorst *s.n.* (U holo; photo in L), Sumatra.

Pahudia javanica subsp. *longiflora* de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1941) 146, f. 2: 2. — *Afzelia javanica* subsp. *longiflora* (de Wit) Léonard, Reinwardtia 1 (1950) 63. — Type: *bb 31600* (U holo; L), Sumatra.

Tree up to 42 m high and 70(–130) cm in diam. Buttresses up to 5 m high, 1.25 m wide and 8 cm thick. Young twigs, rachides, leaflets especially on the midrib of the lower, sometimes also on the upper surface sparsely, sometimes densely pubescent or glabrescent. *Leaves* (4–)6(–8)-jugate; petiole and rachis up to c. 20(–30) cm. *Leaflets* oblong-elliptic or -ovate, rarely ovate or broadly elliptic, 6–9(–16) by 2.5–4(–5.5) cm; apex shortly acuminate, obtuse, rarely retuse; base rounded or obtuse, slightly subcordate, or acute; lateral nerves 7–14 pairs; veins loosely reticulate; petiolules 2–3 mm.

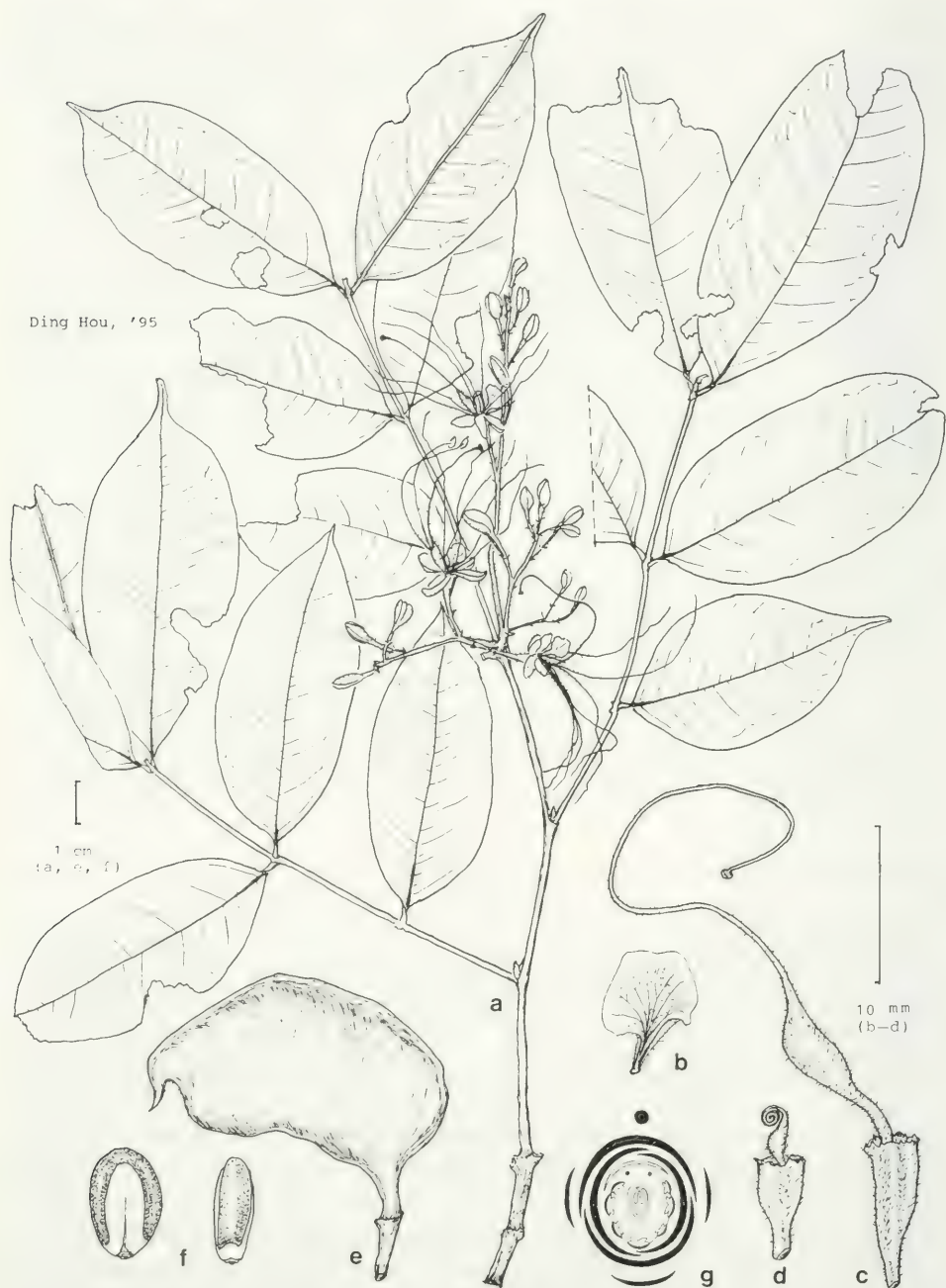


Fig. 3. *Afzelia rhomboidea* (Blanco) Vidal. a. Flowering branch; b. petal, inside view; c, d. opened flowers, with calyx lobes, petal, stamens and staminodes removed, showing two forms of the pistil; e. pod, rather young; f. arillate seed in different views (a, b: Dewel & Patrick SAN 89274; c, d: Elmer 20878; e: Madani SAN 47199; f: Robinson BS 6982). Drawing Ding Hou. — *Afzelia javanica* (Miq.) Léonard. g. Floral diagram, after Prain, Sc. Mem. Med. Off. Army India 12: f. 6).

Inflorescences with rachis often 4–12(–24) cm, pubescent; bracts and bracteoles 3–5 mm long; pedicels 8–12 mm, puberulous. *Hypanthium* 5–7 mm long. *Calyx* lobes broadly elliptic or suborbiculate, 6–10 by 4–7(–9) mm. Developed *petal* 8–10 by 7–9 mm. *Stamens*: filaments (4.5–)5.5–6.5 cm long, united along the lower (1.5–)2–2.5 cm, glabrous except towards the base inside thinly hirsute; anthers 1–1.5 mm long; staminodes c. 4 mm, glabrous. *Ovary* c. 6 mm long, densely puberulous along the margin; style 4–5.5 cm. *Pods* 7–14 by 5–7.5 cm, 1.5–2 cm thick. *Seeds* 1–8, 2–3 by 1.5–2.2 cm, c. 1.3 cm thick. — **Fig. 3g.**

Distribution — *Malesia*: Sumatra (Aceh and East Central), W & C Java.

Habitat & Ecology — In primary and secondary forests, in dry places, rarely occurring on limestone, usually found at 0–100 m, sometimes up to 400(–800) m altitude. Fl. April, Oct.; fr. Jan.–Mar., May, Aug.

Uses — Often cultivated as an ornamental. Timber tree.

2. *Afzelia rhomboidea* (Blanco) Vidal

Afzelia rhomboidea (Blanco) Vidal, Cat. Pl. Prov. Manila (1880) 28; Ding Hou, *Blumea* 38 (1994) 318. — *Eperua rhomboidea* Blanco, Fl. Filip., ed. 2 (1845) 260; ed. 3, 2 (1878) 119, t. 281. — *Intsia rhomboidea* (Blanco) Kuntze, Rev. Gen. Pl. 1 (1891) 192. — *Pahudia rhomboidea* (Blanco) Prain, Sc. Mem. Med. Off. Army India 12 (1901) 46; Merr., Philipp. J. Sc., Bot. 5 (1910) 41; de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1941) 151, f. 2. — Type (Ding Hou 1994): *Merrill Sp. Blanc.* 862 (L neo; BO), Luzon.

Eperua falcata auct. non Aublet: Blanco, Fl. Filip. ed. 1 (1837) 369; Merr., *Sp. Blanc.* (1918) 171.

Intsia acuminata Merr., Publ. Govt. Lab. Philipp. 17 (1904) 20; Enum. Philipp. Flow. Pl. 2 (1923) 257. — Type: *Merrill 1108* (K iso), Luzon.

Afzelia borneensis Harms in Fedde, Rep. 14 (April 1916) 256; 15 (1917) 19. — *Pahudia acuminata* Merr., Philipp. J. Sc., Bot. 11 (June 1916) 86. — *Afzelia acuminata* (Merr.) Harms in Fedde, Rep. 15 (1917) 19. — *Pahudia borneensis* (Harms) Merr., J. Str. Br. Roy. As. Soc. 76 (1917) 84. — Lectotype (Harms 1917): *Hose 93* (L iso), Sarawak.

Pahudia rhomboidea (Blanco) Prain var. *praetermissa* de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1941) 151, f. 2: 3a. — *Afzelia rhomboidea* (Blanco) Vidal var. *praetermissa* Léonard, Reinwardtia 1 (1950) 63. — Syntypes: *Clemens 21289* (L), Sarawak; *bb 8981* (BO, n.v.), Sumatra; *Exp. Nieuwenhuis 1424 & 1509* (BO, n.v.), Kalimantan; *Teijsmann 8249* (BO, n.v.), Kalimantan.

Tree 25–30(–36) m high and 0.4–0.8(–1.2) m in diam. Buttresses sometimes present up to 2 m high, 1–2.5 m wide and c. 8 cm thick. Young twigs, rachides, petioles, petiolules, and leaflets often glabrous, sometimes sparsely, very rarely densely pubescent, especially on the midrib of the lower (sometimes also on the upper) surface. *Leaves* (3-) 4- or 5-jugate; petiole and rachis 10–14(–19) cm. *Leaflets* ovate, elliptic, 3.5–10 (–15) by 2.5–4.5(–6) cm; apex (shortly) acuminate; base acute or obtuse, rarely more or less truncate or shallowly concave; lateral nerves 5–8 pairs, veins rather closely reticulate; petiolules 1.5–4.5 mm. *Inflorescences* with rachis up to 12–14(–15) cm long, both main axis and branches puberulous; pedicels 4.5–5.5 mm. *Hypanthium* c. 3 mm long. *Calyx* lobes broadly ovate or subrotund, 5–12 by 5–9 mm. Developed *petal* yellowish red, red or dark red, 7–10 by 5–9 mm. *Stamens*: filaments 4.5–6 cm, united at the base (or almost free), slightly hairy near the base; anthers c. 1.5 mm long; staminodes (0.5–)1–3 cm, sparsely hairy. *Ovary* 1.5–4 mm long, puberulous along the

margin; style of two kinds: long (40–50 mm) or very short (1–2 mm), slightly hairy at the base. *Pods* 9–12(–20) by 5–7(–10) cm, c. 1.5 cm thick. *Seeds* 1.7–3 by 1.5–2.5 cm, c. 1 cm thick. — **Fig. 3a–f.**

Distribution — *Malesia*: Sumatra (Eastcoast and Palembang), Borneo (Sabah, Kalimantan), Philippines (N Luzon to Mindanao).

Habitat & Ecology — In primary forests, occasionally occurring on limestone or sandstone, up to 350 m altitude, once found at c. 1400 m. Fl. and fr. almost the year round.

Uses — Valuable timber tree.

BAUHINIA

(K. Larsen & S. S. Larsen)

Bauhinia L., Sp. Pl. 1 (1753) 374; DC., Prodr. 2 (1825) 512; Taubert in Engl. & Prantl, Nat. Pflanzenfam. 3, 3 (1891) 147; de Wit, Reinwardtia 3 (1956) 381; Wunderlin, Rhodora 78 (1976) 750; Wunderlin, Larsen & Larsen in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 114; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 12; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 40 pp. — Type species: *Bauhinia divaricata* L.

Phanera Lour., Fl. Coch. (1790) 37; de Wit, Reinwardtia 3 (1956) 135. — Type species: *Phanera coccinea* Lour. [= *Bauhinia coccinea* (Lour.) DC.].

Pauletia Cav., Icon. 5 (1799) 5. — Type species: *Pauletia inermis* Cav. [= *Bauhinia unguolata* L.].

Monoteles Raf., Sylv. Tell. (1838) 122. — Type species: *Monoteles paradoxa* Raf. [= *Bauhinia monandra* Kurz].

Lasiobema Korth., Kruidk. (1841) 84; de Wit, Reinwardtia 3 (1956) 422. — Type species: *Lasiobema scandens* (L.) de Wit [= *Bauhinia scandens* L.].

Piliostigma Hochst., Flora 29 (1846) 598; de Wit, Reinwardtia 3 (1956) 530. — Type species: *Piliostigma reticulatum* (DC.) Hochst. [= *Bauhinia reticulata* DC.].

Gigasiphon Drake in Grandid., Hist. Phys. Madag. 30 (1902) 88; de Wit, Reinwardtia 3 (1956) 418. — Type species: *Gigasiphon humblotianum* (Baill.) Drake [= *Bauhinia humblotiana* Baill.].

Bracteolanthus de Wit, Reinwardtia 3 (1956) 415. — Type species: *Bracteolanthus dipterus* (Blume ex Miq.) de Wit [= *Bauhinia diptera* Miq.].

Lysiphyllum (Benth.) de Wit, Reinwardtia 3 (1956) 431. — Type species: *Bauhinia cunninghamii* (Benth.) Benth.

Trees or *shrubs* (sometimes semiscandent), unarmed or with intrastipular spines (rarely shrubs with tendrils or thorns) or lianas with (rarely without) simple tendrils; branches terete or angular. *Stipules* various, deciduous or persistent; intrastipular trichomes variously developed, sometimes adpetiolarily enlarged and forming a spine. *Leaves* entire, 2-lobate, or 2-foliolate, midrib with weakly to strongly developed secondary veins. *Flowers* solitary or few to many in terminal or subterminal and axillary racemes, corymbs, or panicles (rarely cauliflorous), bisexual or rarely unisexual (polygamous or dioecious). *Hypanthium* short cupulate, campanulate, turbinate, or infundibuliform to long tubular. *Calyx* open or closed at apex, at anthesis spathaceous or irregularly divided to mouth of hypanthium into 2–5 lobes or 5-lobed or -dentate in upper part only. *Petals* (1–)5(–6), white, various shades of red to purple, or yellow, subequal to greatly unequal. Fertile *stamens* 0–10; filaments connate (monadelphous or diadelphous) or free, strongly to weakly declinate; anthers globose, ellipsoid to linear, opening by a longitudinal slit or a central pore in each theca. Reduced stamens or staminodes often present. *Ovary* 1- to many-ovuled; gynophore adnate with abaxial wall of hypanthium

or free; style elongate or obsolete; stigma peltate, capitate or little differentiated from style. *Fruits* flat, suborbicular to broadly elliptic or obovate to linear, woody or thin-valved, dehiscent (often explosively) or indehiscent, continuous, filled, or septate within. *Seeds* orbicular to elliptical, endosperm present or absent.

Distribution — About 300 species all over the tropics. In *Malesia* 69 species.

Habitat — Found in most types of vegetation, evergreen forest, dry deciduous forests and mountain forests, in Africa in savannas and semideserts. In China to over 3000 m altitude, where stunted forms occur in grazing land.

Fossils — Records are few and some uncertain. Newberry [Bull. Torrey Bot. Club 13 (1885) 77] described *Bauhinia cretacea* from Cretaceous clay deposits in New Jersey, USA. The illustration is not really convincing. Berry [Proc. U.S. Nat. Mus. 54 (1917) 115, 144] described another species, *B. potosiana* from Tertiary deposits in Bolivia, a plant with bifoliolate leaves; in our opinion it is questionable if this belongs to the present genus. Kryzhtorich [Amer. J. Sc. 46 (1918) 507] refers to *B. cretacea* from a Miocene flora from Sakhalin. Later references to *Bauhinia* in fossil floras have not been found.

Anatomy — The stem anatomy has been studied in several species and particular attention has been paid to the anomalous growth of several of the large lianas, some producing band-shaped, winged and undulated stems ('monkey-ladders', 'escada das macacos'), due to the cambium being confined to two opposed areas, e.g. *B. scandens*. In *B. vahlii* successive rings of growths are found and in, e.g., *B. championi* a cleft xylem mass is found and one or two successive rings of xylem and phloem; secondary bundles arise in the pith.

Palynology — Pollen in monads (rarely in tetrads), (small), medium to large, inaperturate, 3–7-colpate, 3–7-porate, 3–7-colporate, 3-porate or 3–7-colporoidate, prolate to spheroidal to oblate, sexine various. More than 80% of the species have been studied. For References, see p. 416.

Chromosomes — $2n = 24, 26, 28, 42, 56$. About 40 species have been studied.

Taxonomy — As this large genus comprises a wide range of life-forms from shrubs to trees and lianas and an unusual variation in flower structure some authors as, e.g., latest De Wit (1956) have found it evident to split it into several distinct genera. The present authors have studied the genus from all over its distribution area and found a reticulate pattern of variation. They have drawn the conclusion, now generally accepted among Legume-specialists, that *Bauhinia* in the sense of Linnaeus, Bentham, De Candolle, Taubert, and Hutchinson is an evolutionary unit and a very natural genus.

In the above only generic synonyms related to species occurring in the Malesian area have been mentioned. No less than 26 segregated genera have been created, see Wunderlin (1976) and Wunderlin, Larsen & Larsen (1987).

Pollination — Little has been done to study the genus in nature. From Java (?) come reports on bat-pollination, which is also observed in S America. In several S American species bird-pollination has been observed, while the many medium- and small-flowered species with nectariferous discs probably are entomophilous. Butterfly pollination has been observed in some species in Thailand.

KEY TO THE SUBGENERA

- 1a. Trees or shrubs (rarely semiscandent), sometimes with intrastipular spines, never with tendrils 2
- b. Lianas with tendrils, never with intra-stipular spines or thorns Subg. **Phanera** (p. 458)
- 2a. Calyx spathaceous or dividing to mouth of hypanthium into 2–5 lobes Subg. **Bauhinia** (p. 443)
- b. Calyx closed and irregularly splitting at anthesis Subg. **Elayuna** (p. 456)

Subgenus Bauhinia

Bauhinia subg. *Bauhinia*: Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 11. —

Bauhinia L. sens. str. apud de Wit, Reinwardtia 3 (1956) 390.

Gigasiphon Drake in Grandid., Hist. Phys. Madag. 30 (1902) 88; de Wit, Reinwardtia 3 (1956) 418. —

Bauhinia sect. *Gigasiphon* (Drake) Harms, Bot. Jahrb. 55 (1917) 55.

Trees or shrubs with 2-lobate or 2-foliolate leaves. *Stipules* deciduous, intrastipular trichomes \pm well developed, sometimes spinescent. *Flowers* bisexual or unisexual. *Calyx* during anthesis spathaceous or splitting into 2–5 lobes. *Petals* usually 5. Fertile *stamens* 0–10; anthers ellipsoid-oblong to linear, opening longitudinally. *Pods* flat, woody, dehiscent, rarely indehiscent.

Distribution — 140 species; pantropical.

KEY TO THE SPECIES

- 1a. Leaves \pm deeply bilobed; fertile stamens 0–10 2
- b. Leaves entire, fertile stamens 10 10
- 2a. Fertile stamen 1 **6. B. monandra**
- b. Fertile stamens more than 1 3
- 3a. Fertile stamens 3–5 4
- b. Fertile stamens 10 or absent in female flowers 7
- 4a. Fertile stamens 3 5
- b. Fertile stamens 5 **10. B. variegata**
- 5a. Buds ridged; hypanthium 7–12 mm, flowers pink to purple ... **8. B. purpurea**
- b. Buds smooth, rarely ridged; hypanthium 10–40 mm, flowers white or orange to red 6
- 6a. Leaves up to 5 cm diam.; petals crimson red; cultivated **4. B. galpinii**
- b. Leaves more than 9 cm diam.; petals white or red with yellow centre . **B. pottsii**
- 7a. Buds pointed with 5 free, subulate tips; flowers white 8
- b. Buds without 5 free, subulate tips; flowers yellow or greenish-white 9
- 8a. Buds glabrous or nearly so; pods with sharply raised parallel ridges along the suture; leaf lobes with acute tip **1. B. acuminata**
- b. Buds hirsute; pods without raised sutures; leaf-lobes with blunt tip **5. B. hirsuta**

- 9a. Buds longer than 15 mm; flowers bright yellow **9. *B. tomentosa***
 b. Buds up to 10 mm; flowers greenish-white **11. *B. viridescens***
 10a. Leaves ovate; base cordate to truncate; sepals densely pubescent **3. *B. dolichocalyx***
 b. Leaves lanceolate-acuminate; base rounded or shallowly cordate; sepals sparsely
 pubescent **2. *B. ampla***

1. *Bauhinia acuminata* L.

Bauhinia acuminata L., Sp. Pl. 1 (1753) 375 [Rheede, Hort. Malab. 1 (1678) 61, pl. 34 'Velutta-Mandaru']; Burm. f., Fl. Ind. (1768) 94; Willd., Sp. Pl. 2 (1799) 511; Weinm., Syll. Pl. Nov. Ratisb. 2 (1826) 19; Roxb., Fl. Ind., ed. Carey, 2 (1832) 324; Wight & Arn., Prodr. (1834) 295; Korth., Kruidk. (1841) 84, pl. 9, f. 3; Miq., Fl. Ind. Bat. 1, 1 (1855) 74; Kurz, Fl. Burma 1 (1877) 396; Baker in Hook. f., Fl. Brit. India 2 (1878) 276; Vidal, Cat. Pl. Prov. Manila (1880) 27; Fern.-Vill., Nov. App. (1880) 72; Prain, J. As. Soc. Beng. 59, ii (1890) 244, 246; ibid. 66, ii (1897) 179; Hook. f., Curt. Bot. Mag. 3 (1902) 58, pl. 7866; Perkins, Fragm. Fl. Philipp. (1904) 8; Merr., Philipp. J. Sc., Bot. 5 (1910) 43; Fl. Manila (1912) 230; Enum. Born. Pl. (1921) 297; Enum. Philipp. Flow. Pl. 2 (1923) 258; Backer, Schoolfl. Java (1911) 417; Gagnep. in Fl. Indo-Chine 2 (1913) 148; Ridley, Fl. Malay Penins. 1 (1922) 625; Craib, Fl. Siam. Enum. 1 (1928) 516; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 310; Corner, Wayside Trees (1940) 379; ed. 2 (1952) 379; Bor & Raizada, J. Bombay Nat. Hist. Soc. 42 (1940) 5; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 736; Meijer Drees, Comm. For. Res. Inst. Bogor 33 (1951) 67; de Wit, Reinwardtia 3 (1956) 393; Backer & Bakh. f., Fl. Java 1 (1964) 532; Hô, Illus. Fl. S. Viêt-nam, ed. 2, 1 (1970) 812, f. 2049; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 7; in Fl. Camb., Laos & Vietnam 18 (1980) 156; in Fl. Thailand 4 (1984) 11; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 13; Rudd in Fl. Ceylon 7 (1991) 37. — Type: *Hermann 1: 42, nr. 148* (BM lecto), Sri Lanka.

Bauhinia linnaei Ali, Portug. Act. Biol. Ser. B, 8 (1966) 243. — Type: *A. G. & Lady Bourne 2782* (K holo).

Bauhinia candida auct. non Aiton: DC., Prodr. 2 (1825) 513.

Bauhinia tomentosa auct. non L.: Fern.-Vill., Nov. App. (1880) 72, t. 111.

Bauhinia grandiflora auct. non Blanco: Merr., Philipp. J. Sc., Bot. 2 (1907) 433, nec Juss.

Shrub up to 3 m high. Young branches greyish pubescent, later glabrous. *Leaves*: stipules linear, pubescent, c. 1 cm long, tardily caducous; petiole pubescent, grooved or angular, 3–5 cm; lamina ovate to suborbicular, 12–15(–20) cm diam., 9–11-nerved; bifid 1/3(–1/2); tip of lobes triangular acute, base subtruncate; upper surface glabrous, lower greyish brown pubescent particularly on the nerves. *Inflorescences* lateral and terminal short racemes with 3–10 flowers; pedicels robust, 5–15(–20) mm; bracts and bracteoles linear, acuminate, 6–8 mm; bracteoles inserted below the middle of the pedicel. *Buds* fusiform, thinly hairy to glabrous, c. 4 cm, terminated by 5 free calyx teeth, c. 3 mm long. *Hypanthium* turbinate, 2–6 mm. *Calyx* spathaceous. *Petals* white, subequal, oblong, obtuse, 4–6 cm long with short claw. *Stamens* 10 fertile; filaments hairy at base, 15–25 mm; anthers 3–6 mm with hairy connective. *Ovary* subglabrous, stipitate; style subglabrous, c. 15 mm; stigma small, peltate. *Pods* dehiscent, linear, septate, 11 by 1.5 cm, glabrous, with sharp-rimmed, raised dorsal sutures. *Seeds* 5–11, flat, orbicular, up to 7 mm diam. — **Fig. 4.**

Distribution — SE Asia, described from Sri Lanka, indigenous to the monsoon area of continental SE Asia and *Malesia*: Java, Borneo, Philippines, Timor. It is also widely cultivated and a frequent escape from gardens.

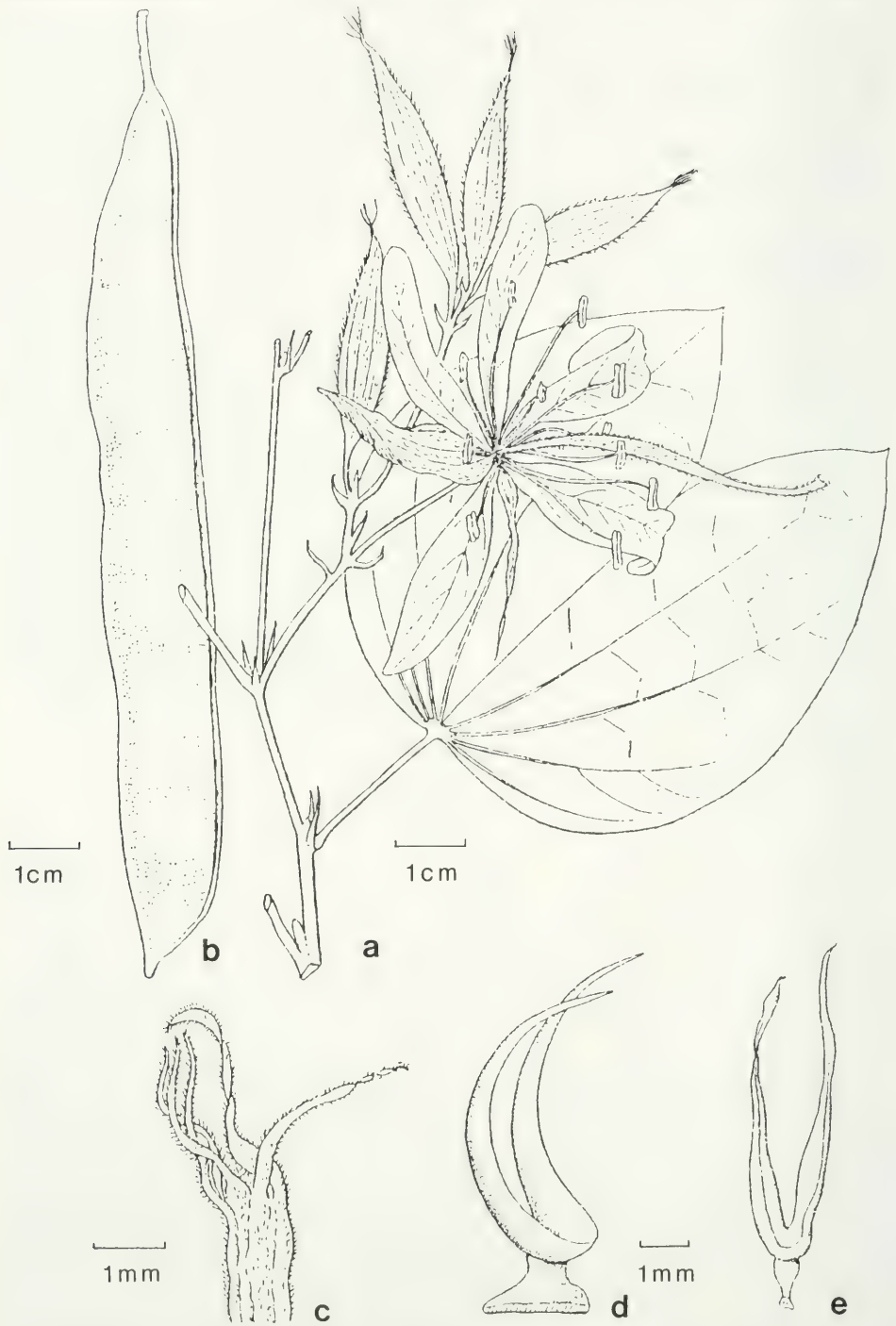


Fig. 4. *Bauhinia acuminata* L. a. Flowering twig; b. pod; c. top of flower bud; d, e. funicular branches. Reproduced from Reinwardtia 3.

Habitat & Ecology — In dry dipterocarp forest in the northern monsoon region; in eastern Java in the lower regions, e. g. in teak forests and brushwood (Backer & Bakh. f., l. c.), also on limestone. It produces flowers throughout the year.

Uses — Ornamental. The roots as well as a powder of the leaves are used medicinally.

2. *Bauhinia ampla* Span.

Bauhinia ampla Span., *Linnaea* 15 (1844) 203; Benth. in Miq., *Pl. Jungh.* (1852) 264; Miq., *Fl. Ind. Bat.* 1, 1 (1855) 76; Wunderlin, Larsen & Larsen, *Biol. Skr. Dan. Vid. Selsk.* 28 (1987) 16. — *Gigasiphon amplum* (Span.) de Wit, *Reinwardtia* 3 (1956) 419. — Type: *de Voogd 2317* (BO neo), Timor. *Bauhinia schlechteri* Harms, *Bot. Jahrb.* 55 (1917) 55; Wunderlin, Larsen & Larsen, *Biol. Skr. Dan. Vid. Selsk.* 28 (1987) 16. — *Gigasiphon schlechteri* (Harms) de Wit, *Reinwardtia* 3 (1956) 421; Verdc., *Manual New Guinea Leg.*, *Lae Bot. Bull.* 11 (1979) 110. — Type: *Schlechter 17550* (L lecto; B, K, SING).

KEY TO THE VARIETIES

- a. Bracteoles near base of pedicel; pedicel c. 2 mm long; hypanthium 8–9(–10) cm long **a. var. ampla**
- b. Bracteoles in upper part of pedicel; pedicel c. 10 mm long; hypanthium 5–7 cm long **b. var. schlechteri**

a. var. *ampla*

Tree up to 13 m high or higher (?); young shoots thinly rusty pubescent, soon glabrous. *Leaves*: stipules linear, sickle-shaped, acute, subglabrous, c. 1 cm long, apparently tardily caducous; petiole up to 3 cm; lamina ovate to lanceolate, up to 22 by 11 cm; 7(–9)-nerved; apex shortly acuminate, base rounded to truncate. *Inflorescences* short, terminal or lateral racemes; pedicels thick, c. 2 mm long; bracts ovate-acute, c. 2 mm; bracteoles similar, inserted at the base of the pedicel. *Buds* clavate, with claw-shaped apex, fugaciously rusty puberulous. *Hypanthium* stout, 8–10 cm long. *Sepals* 5, strap-shaped, sparsely pubescent, acute with swollen apex, 4.5–5 by 0.5 cm. *Petals* white, red at base, obovate, 5–9 cm long, sessile. *Stamens* 10 fertile; filaments 4–5.5 cm, glabrous; anthers ovate elliptic, c. 1 cm. *Stipe of ovary* glabrous as ovary and style; stipe emerging 3–4 cm; style c. 1 cm; stigma indistinct. *Pods* glabrous, up to 30 by 7–8 cm. *Seeds* up to 10, c. 2.5 cm diam., glossy, brown.

Distribution — *Malesia*: Timor, known from only a few localities.

Habitat — Rocky slopes up to 750 m altitude; near the sea.

b. var. *schlechteri* (Harms) K. Larsen & Sunarno

Bauhinia ampla Span. var. *schlechteri* (Harms) K. Larsen & Sunarno, *Nord. J. Bot.* 13 (1993) 658. — *Bauhinia schlechteri* Harms — *Gigasiphon schlechteri* (Harms) de Wit.

Deviates from var. *ampla* in becoming a larger tree, up to 20–30 m. *Leaves* ovate to oblong, base shallowly cordate to rounded; nerves 5–7; stipules early caducous. The

pedicel is longer, up to 10 mm, and the bracteoles are inserted in the upper part. *Hypanthium* 5–7 cm long. *Stamens* perhaps somewhat shorter; stigma small, capitate.

Distribution — *Malesia*: endemic to New Guinea; so far known from two localities only: Albatros Bivak (Irian Jaya) and Madang Province, Papua New Guinea.

Habitat — Marshy forests or river floodplains in rain forest at low altitudes.

3. *Bauhinia dolichocalyx* Merr.

Bauhinia dolichocalyx Merr., Philipp. J. Sc., Bot. 3 (1903) 231; *ibid.* 5 (1910) 44; Enum. Philipp. Flow. Pl. (1923) 259. — *Gigasiphon dolichocalyx* (Merr.) de Wit, Reinwardtia 3 (1956) 420. — Type: Merrill, *Sp. Blanc.* 531 (A neo; K, NSW).

Bauhinia grandiflora Blanco, Fl. Filip. (1837) 332; *ed.* 2, 1 (1845) 231; *ed.* 3, 2 (1878) 67, non Juss. nec Dietr.

Tree up to 25 m high, dbh 20 cm; bark slightly pustular; inner bark orange-brown; wood cream-coloured. *Leaves*: stipules very early caducous, small (?), not seen; petiole slender, 2–3 cm; lamina ovate, entire, acuminate, base cordate to truncate; nerves 5–7 with prominent side branches; upper surface first finely pubescent, later glabrous, lower brownish pubescent when young. *Inflorescences* terminal panicles, axis densely brownish pubescent; pedicels few mm or flowers almost sessile; bracts ovate acute, c. 2 mm long, early caducous; bracteoles similar, inserted just below the hypanthium. *Hypanthium* stout, 6–8 cm long, brownish tomentose, widening towards the mouth. *Buds* spindle-shaped with furrowed apex. *Calyx* splitting into 5 free, linear lobes, 4.5–6.5 cm, densely pubescent on the outer side. *Petals* white, unequal, obovate, 8–10 cm long, up to 6 cm broad, distinctly clawed; claw 3–10 mm long. *Stamens* 10 fertile; filaments glabrous, 4 cm long or longer; anthers linear, 10–14 mm long. *Ovary* long stipitate; stipe 4–5 cm long, glabrous as the ovary and style; style 2–2.5 cm; stigma small, capitate. *Pods* woody, 20–30 by 7–7.5 cm, glabrous, glossy, with strongly marked veins; sutures raised. *Seeds* 2–7, compressed, shining, c. 3 cm diam.

Distribution — *Malesia*: Philippines, Luzon (apparently only known from the type locality and surroundings in Batangas Prov.).

4. *Bauhinia galpinii* N.E. Br.

Bauhinia galpinii N.E. Br., Gard. Chron. 9 (1891) 728; de Wit, Reinwardtia 3 (1956) 398; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 17; Rudd in Fl. Ceylon 7 (1991) 42. — Syntypes: Nelson 409 (K), Saunders (Wood) 3885 (K), Galpin 421 (K, PRE), all S Africa.

Bauhinia punctata Bolle, Peters Reise Moss. 1 (1862) 23, non Jacq.; Oliver in Hook., Ic. Pl. (1891) pl. 1994. — *Phanera punctata* (Bolle) Britt., Sc. Surv. P. R. & Virg. Isl. 6 (1930) 540. — Type: Peters s.n. (B holo †; K), Mozambique.

Shrub, sometimes semiscandent but without tendrils, young branches ± densely brown puberulous. *Leaves*: stipules linear, 1–3 mm long; petiole slender, puberulous, 1–1.5 cm; lamina suborbicular, usually broader than long, up to 5 cm diam., 7-nerved; bifid 1/5–1/4 with broad sinus; tip of lobes rounded, base broadly to shallowly cordate; upper surface glabrous, lower sparsely puberulous and with a marginal zone of yellow scales. *Inflorescences* lateral, short, few-flowered racemes, axis rusty puberu-

lous; pedicels puberulous, c. 5 mm long; bracts subulate, 2 mm; bracteoles minute, setaceous, inserted at the base of hypanthium. *Buds* spindle-shaped, acute, 2–2.5 cm; hypanthium 2–3 cm long, narrow, infundibuliform, densely brown puberulous, finely striate. *Calyx* brown puberulous, splitting spathaceous, finally reflexed, c. 2 cm long. *Petals* spathulate, glabrous, 3–3.5 cm long including the 1.5–2 cm long claw, pinkish red to brick-red. *Stamens* 3, stout, fleshy, nearly as long as petals, glabrous; anthers ellipsoid-oblong, early caducous; staminodes 7, capillary, few mm long. *Ovary* 1 cm, rusty puberulous, stipitate; stipe c. 1 cm long, hairy as ovary; style c. 5 mm, glabrous towards the stigma; stigma inconspicuous. *Pods* thick-valved, 5–7 by 1.5 cm, glabrous, stipitate; stipe c. 1 cm long. *Seeds* 3–5, glossy, brown, oblong to obovate, c. 8 mm across.

Distribution — Native to S Africa. Introduced and cultivated throughout the tropics, but in *Malesia* not commonly grown.

5. *Bauhinia hirsuta* Weinm.

Bauhinia hirsuta Weinm., Syll. Pl. Nov. Ratisb. 2 (1826) 9 [Reinw. apud Blume, Cat. (1823) 68]; Miq., Fl. Ind. Bat. 1, 1 (1855) 76; Backer, Schoolfl. Java (1911) 417; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 736; Backer & Bakh.f., Fl. Java 1 (1964) 532; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 11; in Fl. Camb., Laos & Vietnam 18 (1980) 157; in Fl. Thailand 4 (1984) 13; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 13. — *Bauhinia hirsuta* Korth., Kruidk. (1841) 85, t. 9. — *Bauhinia acuminata* var. *hirsuta* (Korth.) Craib, Fl. Siam. Enum. 1 (1928) 516. — Type: *Korthals s.n.* (L sh. 908.7-254 neo; K), Java.

Bauhinia parvula Gagnep., Bull. Mus. Nat. Hist. Nat. Paris II, 24 (1952) 316. — Type: *Poilane 1342* (P holo), Vietnam.

Bauhinia mollissima auct. non Wall.: Ridley, Fl. Malay Penins. 1 (1922) 626, p.p.

Shrub up to 3 m high. Young branches brownish pubescent, later glabrous. *Leaves*: stipules linear-subulate, c. 1 cm long, caducous; petiole pubescent, grooved or angular, 2–5 cm; lamina suborbicular, often broader than long, 9–16 cm diam., 7–9-nerved; bifid 1/4–1/3 with broad sinus; tip of lobes triangular-obtuse, base shallowly cordate; upper surface glabrous, lower brownish pubescent particularly on the nerves. *Inflorescences*: lateral, short, few-flowered racemes; pedicels 5–15 cm; bracts and bracteoles similar, subulate, 3–6 mm; bracteoles inserted below the middle of the pedicel. *Buds* fusiform, densely pubescent, up to 4 cm long, terminated by 5 free, subulate calyx-teeth, 2–3 mm long. *Hypanthium* turbinate, c. 5 mm. *Calyx* splitting spathaceous at anthesis. *Petals* white, oblong, obtuse, 3–4 by 1.5 cm with short claw. *Stamens* 10 fertile, subequal; filaments 7–20 mm, hairy at base; anthers 2–5 mm. *Ovary* subglabrous; stipitate; style glabrous, 10 mm; stigma small, peltate. *Pods* dehiscent, linear, septate with curved apex, glabrous; sutures not raised as in *Bauhinia acuminata*. *Seeds* 5–10, flat, oblong, up to 8 mm diam.

Distribution — From S China through continental SE Asia; *Malesia*: Malay Peninsula to Java and possibly Madura.

Habitat & Ecology — In dry deciduous forests up to 600 m altitude. Flowers throughout the year.

6. *Bauhinia monandra* Kurz

Bauhinia monandra Kurz, J. As. Soc. Beng. 42, ii (1873) 73; Fl. Burma 1 (1877) 395; Baker in Hook. f., Fl. Brit. India 2 (1878) 285; Prain, J. As. Soc. Beng. 66, ii (1897) 505; Backer, Schoofl. Java (1911) 416; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 260; Craib, Fl. Siam. Enum. 1 (1928) 524; de Wit, Reinwardtia 3 (1956) 401; Backer & Bakh. f., Fl. Java 1 (1964) 532; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 13; in Fl. Camb., Laos & Vietnam 18 (1980) 151; in Fl. Thailand 4 (1984) 6; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 15, 16; Rudd in Fl. Ceylon 7 (1991) 42. — *Caspariopsis monandra* (Kurz) Britt. & Rose, N. Amer. Fl. 23 (1930) 217. — Type: Brandis s.n., Burma (n.v.)

Bauhinia kappleri Sagot, Ann. Sc. Nat. (Bot.) 13 (1882) 317. — Type: No coll. cited in the protologue. *Bauhinia krugii* Urb., Ber. Deutsch. Bot. Ges. 3 (1885) 83. — Syntypes: *Krug* 278, Portorico; *Eggers* 322, St Thomas.

Bauhinia subrotundifolia auct. non Cav.: Fern.-Vill., Nov. App. (1880) 72.

Large *shrub* or *tree* up to 15 m. Young branches rusty pubescent, later glabrous. *Leaves*: stipules triangular, acute, 3–6 mm long; petiole 3–6 cm; lamina broadly ovate to suborbicular, 7–20 cm in diam.; 11–13-nerved; bifid 1/3–1/2 with narrow sinus; tip of lobes rounded to acute, base cordate to truncate; upper surface glabrous, lower pubescent on the nerves. *Inflorescences* short, few-flowered, brownish pubescent racemes; pedicels 10–15 mm, pubescent; bracts lanceolate, c. 10 mm long; bracteoles linear, 3–6 mm long, inserted at the base of the hypanthium. *Buds* c. 22 by 6 mm, fusiform. *Hypanthium* 2.5–3 cm long, narrowly infundibuliform. *Calyx* tomentose, splitting spathaceous, 1.5–2 cm long. *Petals* obovate, 4–5 cm long, gradually tapering towards the short claw; the posterior yellow with large purple spots, the four lateral creamy coloured with pink streaks. *Stamen* 1 fertile; filament c. 4 cm long, hairy at the base; anther sagittate, 6 mm long; staminodes 9, c. 3 mm long. *Ovary* stipitate, as long as the stamen; style sparsely pubescent; stigma oblique, flattened. *Pods* dehiscent, linear, up to 20 by 2 cm, smooth. *Seeds* 10–20, flattened, oblong, black, shining, c. 1 cm diam.

Distribution — Origin unknown; only known as cultivated. Kurz described the species on a collection of Brandis from Burma. Its closest relatives are found in S America and it may be neotropic. The suggestion that it should have originated from Madagascar has not been confirmed. It is widely cultivated in the tropics on account of its showy flowers; in *Malesia* grown all over, but not commonly.

Note — Some authors report the ovary as minute. We have found some flowers with very small ovaries, others with large ones; this may indicate that some flowers are male, others bisexual.

7. *Bauhinia pottsii* G. Don

Bauhinia pottsii G. Don, Gen. Syst. (1832) 462; de Wit, Reinwardtia 3 (1956) 402; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 14; Bot. Tidsskr. 74 (1979) 7; in Fl. Camb., Laos & Vietnam 18 (1980) 154; in Fl. Thailand 4 (1984) 9; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 16. — Type: *Wolfe* s.n. (SING neo).

Bauhinia purpurea auct. non L.: Zoll., Nat. Geneesk. Arch. Neêrl. Indië 3 (1846) 69. See also the lists of synonyms under the varieties.

For typification of the five varieties see Larsen & Larsen (1979); only four of these occur in *Malesia*.

KEY TO THE VARIETIES

- 1a. Petals white, the posterior with a yellow patch: upper leaf surface velvety; ovary patently hairy **c. var. subsessilis**
- b. Petals yellow and orange to red 2
- 2a. Upper leaf surface puberulous, hairs reddish brown; buds reddish brown; ovary hirsute; petals lanceolate, tapering towards the short claw **a. var. pottsii**
- b. Upper leaf surface velvety, greyish green; buds greyish or light brown; ovary appressed pubescent, three posterior petals spatulate with claw longer than or equal to lamina 3
- 3a. Buds clavate with 5 longitudinal ridges, apex crested **d. var. velutina**
- b. Buds terete, tapering towards the acute apex **b. var. mollissima**

a. var. pottsii

Bauhinia pottsii G. Don var. *pottsii*: Larsen & Larsen in Fl. Thailand 4 (1984) 9.

Bauhinia elongata Korth., Kruidk. (1841) 89, t. 24; Miq., Anal. Ind. 1 (1850-52) 12; Fl. Ind. Bat. 1, 1 (1855) 61; Kurz, Fl. Burma 1 (1877) 398; Baker in Hook. f., Fl. Brit. India 2 (1878) 281; Merr., Philipp. J. Sc., Bot. 5 (1910) 46; Backer, Schoolfl. Java (1911) 415; Craib, Fl. Siam. Enum. 1 (1928) 520; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 736. — *Phanera elongata* (Korth.) Benth. in Miq., Pl. Jungh. (1852) 262; Miq., Anal. Ind. 1 (1850-52) 12; Fl. Ind. Bat. 1, 1 (1855) 61. — *Bauhinia pottsii* var. *elongata* (Korth.) de Wit, Reinwardtia 3 (1956) 404.

Shrub often semiscandent, without tendrils. Young branches pubescent, later glabrous. *Leaves*: stipules minute, narrow, acute, early caducous; intrastipular trichomes well-developed; petiole 3–4 cm, pubescent; lamina ovate to rotundate, 9–14 by 10–15 cm, 11–15-nerved; bifid 1/3(–1/2) with broad sinus; tip of lobes rounded, base cordate; upper surface brownish puberulous to glabrescent; lower surface rusty pubescent particularly on nerves. *Inflorescences* lateral and terminal racemes up to 10 cm long, axis brownish pubescent; pedicels 1–1.5 cm; bracts triangular, 3–5 mm, brownish tomentose; bracteoles similar, inserted about the middle of the pedicel. *Buds* 3–4 cm long, elongate, red-brown velvety. *Hypanthium* tubular, as long as bud. *Calyx* splitting into 2–5 reflexed segments. *Petals* red with yellow centre, lanceolate, 4–6 cm long, with claw shorter than blade; the posterior broader than the lateral. *Stamens* 3 fertile; filaments glabrous, 3–4.5 cm; anthers linear, 10–12 mm; staminodes few (usually 2), minute, subulate. *Ovary* reddish brown hirsute, 1–1.5 cm with a 1–2 cm long hirsute stipe; style 2–3 cm, hirsute; stigma peltate. *Pods* dehiscent, velvety with raised dorsal suture, strap-shaped, broadest toward acuminate, beaked apex. *Seeds* 4–6, flattened, orbicular, 1–1.5 cm diam.

Distribution — S Burma, S Thailand; *Malesia*: Malay Peninsula, Borneo, Java.

Habitat — Along margin of forests at lower altitudes, also along rivers, ditches and in swampy places.

b. var. mollissima (Prain) K. & S.S. Larsen

Bauhinia pottsii G. Don var. *mollissima* (Wall. ex Prain) Larsen & Larsen, Bot. Tidsskr. 74 (1979) 8; in Fl. Thailand 4 (1984) 10. — *Bauhinia mollissima* [Wall., Cat. no. 5782] Prain, J. As. Soc. Beng. 66, ii (1890) 180, 183, 185, 499, 502; Brandis, Ind. Trees (1906) 259; Ridley, Fl. Malay Penins. 1 (1922) 626. — Type: *Wallich Cat.* 5782 (K holo), Penang.

Deviates from var. *pottsii* in the greyish green upper leaf surface, velvety, sometimes with a 'mouldy' look; the greyish to light brown buds; the appressed pubescent ovary; the three posterior petals are spatulate with claw longer than or equal to the lamina. The 'mouldy' look is apparently due to some scaly excretions or glands.

Distribution — Restricted to the west coast of the Malay Peninsula from Ranong (Thailand) southwards to Malacca and with occurrence on adjacent Sumatra. One collection from northern Burma may be due to mixing of labels.

Habitat — As var. *pottsii*.

c. var. *subsessilis* (Craib) de Wit

Bauhinia pottsii G. Don var. *subsessilis* (Craib) de Wit, Reinwardtia 3 (1956) 406; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 14; Bot. Tidsskr. 74 (1979) 11; in Fl. Camb., Laos & Vietnam 18 (1980) 154; in Fl. Thailand 4 (1984) 10. — *Bauhinia subsessilis* Craib, Kew Bull. (1927) 392; Fl. Siam. Enum. 1 (1928) 529. — Type: *Kerr 9207* (K holo; AAU, ABD, E), Thailand.

This variety deviates from the other varieties in being white-flowered. Petals lanceolate with short claw, the posterior one with a yellow patch. Easily distinguished from other varieties also by the patently, densely hairy ovary. Pods nearly glabrous, dorsal suture not raised. The leaves have a rusty velvety upper surface.

Distribution — S Cambodia, S & SE Thailand; *Malesia*: one locality in Peninsular Malaysia (Perlis).

Habitat — As var. *pottsii*.

d. var. *velutina* (Benth.) K. & S. S. Larsen

Bauhinia pottsii G. Don var. *velutina* (Wall. ex Benth.) Larsen & Larsen, Bot. Tidsskr. 74 (1979) 8; in Fl. Thailand 4 (1984) 10. — *Phanera velutina* Benth. in Miq., Pl. Jungh. (1852) 262. — *Bauhinia velutina* [Wall. ex] Baker in Hook. f., Fl. Brit. India 2 (1878) 280; Fischer, Kew Bull. (1927) 87. — Type: *Wallich Cat. 5781* (K lecto), Burma.

Resembling var. *mollissima*, the upper leaf surface is also velvety, and very often with the characteristic 'mouldy' look; but it deviates by the lower surfaces which are greyish pubescent, and the clavate buds with 5 longitudinal ridges and crested apex.

Distribution — S Burma, Peninsular Thailand. It may occur in the northern part of Peninsular Malaysia.

Habitat — As var. *pottsii*.

8. *Bauhinia purpurea* L.

Bauhinia purpurea L., Sp. Pl. 1 (1753) 375 [Rheede, Hort. Malab. 1 (1678) 57, pl. 33 'Chovanna-Mandaru']; Burm. f., Fl. Ind. (1768) 94; Willd., Sp. Pl. 2 (1799) 511; Roxb., Fl. Ind., ed. Carey, 2 (1832) 320; Wight & Arn., Prodr. (1834) 296; Blanco, Fl. Filip., ed. 2 (1845) 231; ed. 3 (1878) 66; Kurz, J. As. Soc. Beng. 45, ii (1876) 288; Fl. Burma 1 (1877) 398; Baker in Hook. f., Fl. Brit. India 2 (1878) 284; Trim. & Hook. f., Fl. Ceyl. 2 (1894) 117; Prain, J. As. Soc. Beng. 66, ii (1897) 180; Backer, Schoolfl. Java (1911) 416; Koord., Exk. Fl. Java 2 (1912) 366; Gagnep. in Fl. Indo-Chine 2 (1913) 127; Merr., Sp. Blanc. (1918) 172; Ridley, Fl. Malay Penins. 1 (1922) 634; Craib, Fl. Siam. Enum. 1 (1928) 526; Burkill, Dict. Econ. Prod. Malay Penins. 1 (1935) 311; Corner, Wayside Trees (1940) 330, f. 129; de Wit, Reinwardtia 3 (1956) 406; Backer & Bakh. f., Fl. Java 1

(1964) 533; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 15; Huang, Fl. Taiwan 3 (1977) 181; Hara, Enum. Flow. Pl. Nepal 1 (1979) 108; Larsen & Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 152; in Fl. Thailand 4 (1984) 7; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 15; Rudd in Fl. Ceylon 7 (1991) 42. — *Phanera purpurea* (L.) Benth. in Miq., Pl. Jungh. (1852); Miq., Fl. Ind. Bat. 1, 1 (1855) 60. — Type: *Merrill Sp. Blanc. 1050* (L. neo), Philippines.

Bauhinia coromandeliana DC., Prodr. 2 (1825) 515. — Type: no collections cited in protologue, from India near Pondichéri.

Bauhinia triandra Roxb., Fl. Ind., ed. Carey, 2 (1832) 320; ed. Clarke (1874) 345. — Type: no collections cited, described from a specimen in Bot. Gard. Calcutta, originating from Bengal.

Bauhinia castrata Blanco, Fl. Filip. (1837) 331. — Type: no collections cited.

Bauhinia rosea Corner, Wayside Trees (1940) 380, nom. illeg. non Miq. nec Kurz. — *Bauhinia purpurea* var. *corneri* de Wit, Reinwardtia 3 (1956) 409. — Type: *Furtado s.n.* (SING holo), Bot. Gard. Singapore, Nov. 1935.

Bauhinia violacea Corner, Wayside Trees (1940) 383, nom. illeg. — *Bauhinia purpurea* var. *violacea* de Wit, Reinwardtia 3 (1956) 409. — Type: *Henderson s.n.* (SING holo), Bot. Gard. Singapore, Sept. 1935.

Shrub or small *tree* up to 10 m. Young branches glabrescent. *Leaves*: stipules minute, 1–2 mm long; petiole 2–3 cm; lamina suborbicular up to 12 cm diam., 9–13-nerved; bitid 1/3–1/2 with narrow to broad sinus; tip of lobes rounded to acute, base rounded to cordate; upper surface glabrous, lower sparsely hairy. *Inflorescences* lateral and terminal racemes, 6–10-flowered; pedicels thick, 1–1.5 cm; bracts ovate acute, 1–2 mm long; bracteoles similar, inserted at about the middle of the pedicel. *Buds* clavate, velvety, greyish green, 4–5 angled mainly towards the \pm twisted apex, 3–4 cm long. *Hypanthium* turbinate, 7–12 mm long. *Calyx* splitting spathaceous. *Petals* narrowly lanceolate, the posterior oblanceolate, 3–5 cm long, claw 5–10 mm, pink to dark purple. *Stamens* 3 fertile; filaments shortly connate at base, 3–4 cm long; anthers 5–7 mm long; staminodes 5 or 6, filiform, 6–10 mm long. *Ovary* velvety, 1 cm long, stipitate, stipe 1 cm; style short; stigma oblique, flat. *Pods* dehiscent, linear, 20–25 by 1.5–2.5 cm, glabrous, irregularly veined. *Seeds* c. 10; flat, orbicular, c. 15 mm diam.

Distribution — Native of tropical Asia, probably only in the continental monsoon area northwest to Nepal. Cultivated throughout S and SE Asia; it occurs occasionally as an escape from cultivation as e.g. in Java near Songgoriti, altitude 1000 m.

Notes — 1. There is a certain variation in flower colour from deep purple to pale pink, in our opinion without taxonomic significance.

2. The sterile hybrid *Bauhinia purpurea* \times *variegata* [*B. blakeana* Dunn, J. Bot. Lond. 4 (1908) 325; de Wit, Reinwardtia 3 (1956) 397] is also widely cultivated and according to our experience more common than *B. purpurea* as wayside and park tree. The pollen is very irregular and probably most of it not viable; pods are usually not produced. It is rather intermediate between the parents in floral morphology but has 5 stamens as *B. variegata*.

9. *Bauhinia tomentosa* L.

Bauhinia tomentosa L., Sp. Pl. 1 (1753) 375; Burm. f., Fl. Ind. (1768) 94; Willd., Sp. Pl. 2 (1799) 511; Ham., Trans. Linn. Soc. 13 (1822) 498; DC., Prodr. 2 (1825) 514; Roxb., Fl. Ind., ed. Carey, 2 (1832) 323; Wight & Arn., Prodr. (1834) 295; Korth., Kruidk. (1841) 85; Hassk., Pl. Jav. Rar.

(1848) 410; Benth. in Miq., Pl. Jungh. (1852) 261; Miq., Fl. Ind. Bat. 1, 1 (1855) 75; Baker in Hook. f., Fl. Brit. India 2 (1878) 275; Trimen, Fl. Ceylon 2 (1894) 116; Prain, J. As. Soc. Beng. 66, ii (1897) 178; Backer, Schoolfl. Java (1911) 417; Koord., Exk. Fl. Java 2 (1912) 366; Compton, J. Linn. Soc. Bot. 41 (1912) 14; Gagnep. in Fl. Indo-Chine 2 (1913) 148; Ridley, Fl. Malay Penins. 1 (1922) 634; Craib, Fl. Siam. Enum. 1 (1928) 531; Corner, Wayside Trees (1940) 382; ed. 2 (1952) 382; Bor & Raizada, J. Bombay Nat. Hist. Soc. 42 (1940) pl. 4; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 737; Quisumb., Med. Pl. Philipp. (1951) 368; de Wit, Reinwardtia 3 (1956) 409; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 18; in Fl. Camb., Laos & Vietnam 18 (1980) 158; in Fl. Thailand 4 (1984) 14; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 14, Rudd in Fl. Ceylon 7 (1991) 38. — Type: *Cult. Hort. Bogor* (L sh. 950.287-613 neo).

Bauhinia pubescens DC., Mem. Leg. (1827) 483. — Type: Burman, Thes. Zeyl. 44, t. 18.

Tree up to 4 m; young branches brownish pubescent. *Leaves*: stipules linear, c. 1 cm; petiole pubescent, 1–3 cm; lamina suborbicular, often broader than long, 4–8 cm diam., 7–9-nerved; bifid 1/3–1/2 with broad sinus; tip of lobes rounded; base truncate to shallowly cordate; upper surface glabrous, lower brownish pubescent. *Inflorescences* lateral, few-flowered, short racemes; pedicels c. 1 cm; bracts subulate, c. 5 mm; bracteoles similar but smaller, inserted about the middle of the pedicel. *Buds* fusiform, puberulous, 2 cm including the hypanthium. *Hypanthium* turbinate, 5 mm. *Calyx* splitting spathaceous during anthesis. *Petals* yellow or yellow with a dark purple blotch on the median petal, subequal, broadly obovate, 4–5 cm, short-clawed. *Stamens* 10 fertile, unequal; filaments 1–2 cm, pubescent at base; anthers 2–3 mm. *Ovary* shortly stipitate, white tomentose; style glabrous towards the peltate stigma. *Pods* dehiscent, flat, linear, velutinous, 7–15 by 1–1.5 cm. *Seeds* c. 5, flat, suborbicular, c. 1 cm diam.

Distribution — Origin in tropical Asia, probably spontaneous in India. In *Malesia* only cultivated.

10. *Bauhinia variegata* L.

Bauhinia variegata L., Sp. Pl. 1 (1753) 375 [Rheede, Hort. Malab. 1 (1678) 52, pl. 32 'Chovanna-Mandaru', i.e. as *Bauhinia purpurea*]; Willd., Sp. Pl. 2 (1759) 54; Burm. f., Fl. Ind. (1768) 94; DC., Prodr. 2 (1825) 514; Roxb., Fl. Ind., ed. Carey, 2 (1832) 319; Wight & Arn., Prodr. (1834) 296; Zoll., Nat. Geneesk. Arch. Neêrl. Indië 3 (1846) 69; Hassk., Pl. Jav. Rar. (1848) 409; Kurz, Fl. Burma 1 (1877) 397; Baker in Hook. f., Fl. Brit. India 2 (1878) 284; Prain, J. As. Soc. Beng. 66, ii (1897) 550; Backer, Schoolfl. Java (1911) 416; Gagnep. in Fl. Indo-Chine 2 (1913) 145; Bamber, Fl. Punjab (1916) 22; Craib, Fl. Siam. Enum. 1 (1928) 531; Corner, Wayside Trees (1940) 382; ed. 2 (1952) 382; de Wit, Reinwardtia 3 (1956) 411; Backer & Bakh. f., Fl. Java 1 (1964) 532; Hô, Illus. Fl. S. Vietnam, ed. 2, 1 (1970) 813, f. 2052; Hara, Enum. Pl. Nepal (1979) 109; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1972) 262; in Fl. Camb., Laos & Vietnam (1980) 155, pl. 26/4–7; in Fl. Thailand 4 (1984) 11, pl. I/1, f. 1/4–5; Saldanha, Fl. Karnataka 1 (1985) 378; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 15; Rudd in Fl. Ceylon 7 (1991) 43. — *Phanera variegata* (L.) Benth., Pl. Jungh. (1852) 52; Miq., Fl. Ind. Bat. 1, 1 (1855) 60. — Type: *Rep. Econ. Prod. India 12187* (L neo).

Bauhinia candida Aiton, Hort. Kew. 2 (1789) 49; Willd., Sp. Pl. 2 (1799) 510; DC., Prodr. 2 (1825) 513; Roxb., Fl. Ind., ed. Carey, 2 (1832) 319; ed. Clarke (1874) 344. — *Bauhinia variegata* var. *candida* (Aiton) Corner, Wayside Trees (1940) 383; ed. 2 (1952) 383. — To be typified.

Bauhinia variegata var. *alboflava* de Wit, Reinwardtia 3 (1956) 412. — Type: *Kiah s.n.* (SING, n.v.), Singapore Bot. Gard.

Tree up to 15 m tall. Young branches greyish pubescent, later glabrous. *Leaves*: stipules minute, 1–2 mm, early caducous; petioles puberulous to glabrous, 3–4 cm; lamina broadly ovate to circular, often broader than long, 6–16 cm diam.; 11–13-nerved; bifid 1/4–1/3 with broad sinus; tip of lobes broadly rounded, base cordate; upper surface glabrous, lower glaucous and when full grown glabrous. *Inflorescences*: flowers in very short, few-flowered racemes from the older twigs, axis tomentose; bracts triangular, very small, early caducous; bracteoles similar, inserted below the middle of the pedicel; pedicel 3–5 mm. *Buds* fusiform, 3–4 cm, finely hairy. *Hypanthium* infundibuliform, c. 15 mm long. *Calyx* splitting spathaceous. *Petals* somewhat unequal, white or violet, obovate, 4–5.5 cm long with a short claw, margin often crisped. Fertile *stamens* 5, unequal; filaments 2–4 cm; anthers 6–7 mm, elliptic; staminodes 5, capillary, 0.5–1 cm long. *Ovary* pubescent, particularly along the sutures, c. 2 cm, stipe pubescent, 1.5 cm; style short; stigma small, capitate. *Pods* dehiscent, strap-shaped, obliquely striate, 20–30 by 2–2.5 cm. *Seeds* 10–25, flat, orbicular, 10–15 mm diam.

Distribution — S China, Burma, N Thailand, Laos and N Vietnam. Widely cultivated in the tropics, also in *Malesia*.

Habitat — Deciduous forest from 500–1500 m altitude.

Uses — The flowers are edible and in several places in continental E Asia also used for medical purposes. In the Malesian area only known as an ornamental tree.

Note — White flowered and violet flowered individuals occur intermixed.

11. *Bauhinia viridescens* Desv.

Bauhinia viridescens Desv., Ann. Sc. Nat. 9 (1826) 429; Gagnep. in Fl. Indo-Chine 2 (1913) 147; de Wit, Reinwardtia 3 (1956) 413; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 18; in Fl. Camb., Laos & Vietnam 18 (1980) 161; Thai For. Bull. 13 (1980) 43; in Fl. Thailand 4 (1984) 16; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 14, 15. — Type: *Anon. s.n.* (P lecto), Timor.

Bauhinia timorana Deene., Nouv. Ann. Mus. Paris 3 (1834) 466; Herb. Timor. Deser. (1835) 138; Span., Linnaea 15 (1841) 202; Baker in Hook. f., Fl. Brit. India 2 (1878) 276, '*B. timoriensis*'. — To be typified.

Bauhinia polycarpa Wall. ex Benth. in Miq., Pl. Jungh. (1852) 261; Burm. f., Fl. Burma 1 (1877) 396; Baker in Hook. f., Fl. Brit. India 2 (1878) 276; Craib, Fl. Siam. Enum. 1 (1928) 525. — Type: Wallich Cat. 5787 (K lecto; BM), Burma.

Bauhinia baviensis Drake in Morot, J. Bot. 5 (1891) 217. — *Bauhinia viridescens* var. *baviensis* (Drake) de Wit, Reinwardtia 3 (1956) 414. — Type: *Balansa* 2137 (P lecto), Vietnam.

Shrub up to 4 m. Young branches slender, glabrous or (less common) patently hirsute. *Leaves*: stipules from setiform to triangular, puberulous, 2–3 mm; intrastipular spines often well-developed into curved thorns, 2–3 mm; petiole ± pubescent, 2–5 cm; lamina ovate, sometimes broader than long, 6–15 cm diam.; 7–11-nerved; bifid 1/3–2/3, usually with broad sinus; tip of lobes obtuse or acute, base truncate to cordate; upper surface glabrous, lower glabrescent or shortly pubescent particularly on the nerves. *Inflorescences* lateral and terminal narrow racemes, 5–15 cm; pedicels glabrous, 2–3 mm; bracts ovate, acute, 2–5 mm; bracteoles minute, inserted near the base of the pedicel. *Buds* ellipsoid to fusiform (varying according to presence or absence of ovary).

glabrous, 6–10 mm. *Hypanthium* very short, turbinate, c. 1 mm. *Calyx* splitting spatheously during anthesis. *Petals* greenish white, obovate to lanceolate, 7–12 mm; claw short. *Male flowers*: *stamens* 10 fertile, shorter than petals, the 5 outer the longest; filaments hairy at the base; anthers oblong, 1–2 mm. *Female flowers*: reduced *stamens* 10, unequal; *ovary* shortly stipitate, 6–8 mm, pubescent; style very short; stigma peltate. *Pods* dehiscent, flat, short-beaked, strap-shaped, pubescent when young, 5–7 by 0.7–1 cm. *Seeds* 6–10, compressed, orbicular, 3–4 mm diam.

Distribution — Monsoon area of Burma, Thailand, Cambodia, Laos, and Vietnam. South of equator found under similar conditions in *Malesia*: Timor and Wetar (Lesser Sunda Islands).

Habitat — Lower altitudes, in dry deciduous forests often in scrub and among bamboo; found on various soil types.

Note — *Bauhinia viridescens* is a very variable species particularly concerning leaf size and indumentum. The Malesian material from Timor and Wetar belongs to var. *viridescens*.

Subgenus *Elayuna*

Bauhinia subg. *Elayuna* (Raf.) Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 17.

— *Elayuna* Raf., Sylv. Tell. (1838) 145. — Type species: *Bauhinia reticulata* A.P. DC.

Bauhinia (without rank) *Griponeura* Korth., Kruidk. (1841) 84. — Type species: *Bauhinia reticulata* A.P. DC.

Piliostigma Hochst., Flora 29 (1846) 589; Benth. in Miq., Pl. Jungh. (1852) 261; Milne-Redh., Hook. Ic. Pl. (1947) pl. 3460; de Wit, Reinwardtia 3 (1956) 530. — *Bauhinia* sect. *Piliostigma* (Hochst.) Taub. in Engl. & Prantl, Nat. Pflanzenfam. 3, 3 (1891) 149. — *Bauhinia* sect. *Pileostigma* Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 576. — Type species: *Piliostigma reticulatum* (A.P. DC.) Hochst. [= *Bauhinia reticulata* A.P. DC.]

Trees or *shrubs*, unarmed (in palaeotropics) or with thorns. *Leaves* bilobed; intra-stipular trichomes small. *Flowers* unisexual (dioecious) or bisexual. *Hypanthium* short, turbinate. *Calyx* 2–5-lobed or -dentate in upper part. *Petals* 5, subequal. *Male flowers*: *stamens* 10 free; anthers opening by longitudinal slits. *Female flowers*: *stigma* large, peltate. *Pods* linear oblong, woody, indehiscent or dehiscent. *Seeds* suborbicular, one funicular aril-lobe long, the other short.

Distribution — Six species, pantropical, only one in *Malesia*.

12. *Bauhinia malabarica* Roxb.

Bauhinia malabarica Roxb., Hort. Beng. (1814) 31, nom. nud.; Fl. Ind., ed. Carey, 2 (1832) 321; Wight & Arn., Prodr. (1834) 294, 295; Baker in Hook. f., Fl. Brit. India 2 (1878) 277; Vidal, Cat. Pl. Pr. Manila (1886) 27; Rev. Pl. Vasc. Filip. (1886) 117; Koord. & Valetton, Bijdr. Booms. Java 2 (1895) 24; Perkins, Fragm. Fl. Philipp. 1 (1904) 8; Backer, Schoolfl. Java (1911) 416; Gagnep. in Fl. Indo-Chine 2 (1913) 146; Merr., Sp. Blanc. (1918) 172; Craib, Fl. Siam. Enum. 1 (1928) 524; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 737; Quisumb., Med. Pl. Philipp. (1951) 367; Meijer Drees, Comm. For. Res. Inst. Bogor 33 (1951) 68; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 12; in Fl. Camb., Laos & Vietnam 18 (1980) 162; in Fl. Thail. 4 (1984) 19; Wunderlin, Larsen &

- Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 18. — *Piliostigma malabaricum* (Roxb.) Benth. in Miq., Pl. Jungh. (1852) 261; Miq., Fl. Ind. Bat. 1, 1 (1855) 73; de Wit, Reinwardtia 3 (1956) 531; Backer & Bakh. f., Fl. Java 1 (1964) 533; Hô, Illus. Fl. S. Viêt-nam, ed. 2, 1 (1970) f. 2065. — Type: *Roxburgh s.n.* (not found, no corresponding illustration).
- Bauhinia acida* Reinw. ex Korth., Kruidk. (1841) 86. — *Pauletia acida* (Reinw. ex Korth.) Hassk., Flora 31 (1848) 578. — *Piliostigma acidum* (Reinw. ex Korth.) Benth. in Miq., Pl. Jungh. (1852) 261; Miq., Fl. Ind. Bat. 1, 1 (1855) 72. — Type: *Reinwardt s.n.* (L. sh. 908.112-109 holo).
- Casperea castrata* (Hassk.) Hassk., Pl. Jav. Rar. (1848) 412. — *Bauhinia castrata* Hassk., Flora 25, Beibl. (1842) 96. — Type: unknown.
- Bauhinia platyphylla* Zipp. ex Miq., Fl. Ind. Bat. 1, 1 (1855) 73. — To be typified.
- Bauhinia rugulosa* Blume ex Miq., Fl. Ind. Bat. 1, 1 (1855) 73. — To be typified.
- Bauhinia hawkesiana* F.M. Bailey, Queensl. Agr. J. 15 (1905) 897. — Type: Not distinctly cited in the protologue.
- Bauhinia purpurea* auct. non L.: DC., Prodr. 2 (1825) 515, quoad spec. Timor; Vidal, Sin. Atlas 24 (1883) pl. 43, f. A.
- Bauhinia tomentosa* auct. non L.: Blanco, Fl. Filip. (1837) 330; ed. 2 (1845) 230; ed. 3 (1878) 65, pl. 118 (sub *Piliostigma acidum* Benth.).

Dioecious *tree* up to 15 m tall. Young branches pubescent to almost glabrous. *Leaves*: stipules linear-acute, 2–3 mm, very early caducous; petiole glabrous to pubescent, 2–4 cm; lamina ovate to rotundate, 4–12 by 8–16 cm; 9–11-nerved; bifid 1/6–1/3 with wide sinus; tip of lobes rounded, base truncate to cordate; upper surface light green to subglaucous, sparsely pubescent; glaucous (greyish white when dry) and glabrous to pubescent below. *Inflorescences* short, simple or few-branched racemes from the leaf-axils, up to 5 cm; bracts very small, triangular; pedicels filiform, 1–2 cm, pubescent, with very reduced bracteoles, inserted variously, c. 1 mm, \pm persistent. *Buds* club-shaped, pubescent, 6–10 mm, the female larger than the male. *Hypanthium* turbinate, 3–5 mm, longest in the female flowers. *Calyx* splitting into 2–3(–5) lobes in the upper part. *Petals* white, oblong, c. 10 mm with short claw. *Male flowers*: fertile *stamens* 10, shorter than the petals, outer whorl longest; filament glabrous; anthers oblong, 2 mm. *Female flowers*: staminodes 10, very small; *ovary* stipitate, 5–6 mm, densely tomentose; style short; stigma peltate. *Pods* indehiscent or tardily dehiscent; strap-shaped, often slightly bent and terminated by a long, straight beak; the surface finely striate, glabrous, 20–25 by 1–1.5 cm. *Seeds* 10–30, rounded-elliptic, 7 mm in diam., dark brown.

Distribution — On the northern hemisphere from India through Burma, Thailand, Cambodia, Laos and Vietnam to the Philippines, on the southern in *Malesia* from Java to Timor and in Queensland, Australia. It is lacking on the Malay Peninsula.

Habitat — A typical species for the dryer, deciduous, monsoon forests at lower altitudes, rarely found above 300 m altitude.

Note — We have included var. *acida* of De Wit or *Bauhinia acida* of earlier authors in the species as we do not find the characters, mainly based on the leaves, sufficient to maintain a separate taxon. Our experience from field studies shows that there is a clinal variation between populations with glabrous and pubescent leaves; often the latter are most common in the driest areas; var. *acida* was also established on the character of sour-tasting shoots; this field character has to be reinvestigated.

Subgenus *Phanera*

- Bauhinia* subg. *Phanera* (Lour.) Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 18.
 — *Phanera* Lour., Fl. Cochinch. (1790) 37; Benth. in Miq., Pl. Jungh. (1852) 263; Miq., Fl. Ind. Bat. 1, 1 (1855) 58; de Wit, Reinwardtia 3 (1956) 435; Backer & Bakh. f., Fl. Java 1 (1964) 453.
 — Type species: *Phanera coccinea* Lour. [= *Bauhinia coccinea* (Lour.) DC.].
- Bauhinia* subg. *Lasiobema* Korth., Kruidk. (1841) 84; Baker in Hook. f., Fl. Brit. India 2 (1878) 284.
 — *Lasiobema* (Korth.) Miq., Fl. Ind. Bat. 1, 1 (1855) 71; de Wit, Reinwardtia 3 (1956) 422; Backer & Bakh. f., Fl. Java 1 (1964) 534. — Type species: *Bauhinia scandens* L.
- Bauhinia* sect. *Loxocalyx* Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 576. — Type species: *Bauhinia wallichii* Macbr.
- Lysiphyllum* (Benth.) de Wit, Reinwardtia 3 (1956) 431; Backer & Bakh. f., Fl. Java 1 (1964) 535. — *Bauhinia* sect. *Lysiphyllum* Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 576. — Type species: *Bauhinia cunninghamii* (Benth.) Benth.
- Bracteolanthus* de Wit, Reinwardtia 3 (1956) 415. — Type species: *Bracteolanthus dipterus* (Miq.) de Wit [= *Bauhinia diptera* Miq.].

Tendrilled *lianas* (in Malesia). *Leaves* entire, bilobed or bifoliolate. *Hypanthium* ± elongate, sometimes dilated at base or turbinate. *Calyx* closed or open at apex before anthesis, splitting irregularly into 2–5 lobes or regularly into 5 lobes, or dentate in upper part only. *Petals* subequal to unequal; nectariferous disc present or absent. Fertile *stamens* 2, 3, or 10; reduced stamens or staminodes often present; anthers opening by longitudinal slits. *Pods* flat, woody or thin-valved, dehiscent or indehiscent.

Distribution — 150 species, pantropical but most abundant in SE Asia and S America.

KEY TO THE SECTIONS

(valid for Malesian species)

- 1a. Leaves bifoliolate on flowering shoots; fertile stamens 10 Section **Lysiphyllum** (p. 501)
- b. Leaves entire or bilobed on flowering shoots; fertile stamens 3, rarely 2 2
- 2a. Anthers opening by a central pore Section **Palmatifolia** (p. 505)
- b. Anthers opening by a slit lengthwise 3
- 3a. Nectariferous disc present Section **Lasiobema** (p. 499)
- b. Nectariferous disc absent 4
- 4a. Flowers pseudopapilionaceous; fleshy, digitate body present on the rim of hypanthium Section **Austrocercis** (p. 498)
- b. Flowers not pseudopapilionaceous; fleshy digitate body absent 5
- 5a. Calyx open at apex before anthesis, remaining campanulate Section **Tubicalyx** (p. 532)
- b. Calyx closed before anthesis, splitting into 2–5 lobes . Section **Phanera** (p. 458)

Section *Phanera*

- Bauhinia* sect. *Phanera* (Lour.) Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 18.
Phanera subg. *Phanera* sect. *Meganthera* de Wit, Reinwardtia 3 (1956) 440. — Type species: *Bauhinia semibifida* Roxb.

Phanera subg. *Phanera* sect. *Phanerosiphon* de Wit, Reinwardtia 3 (1956) 438. — Type species: *Phanera sylvani* de Wit [= *Bauhinia sylvani* (de Wit) Cusset].

Phanera subg. *Phanera* sect. *Micranthera* de Wit, Reinwardtia 3 (1956) 470. — Type species: *Bauhinia integrifolia* Roxb.

Bauhinia sect. *Loxocalyx* Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 576. — Type species: *Bauhinia wallichii* Macbr.

Leaves entire or bilobed. *Hypanthium* turbinate to long tubular. *Calyx* irregularly split into 2–5 lobes; nectariferous disc absent or replaced by a red tubular outgrowth arising from the margin of hypanthium (*B. bracteata*). Fertile *stamens* 3, rarely 2 (*B. bassacensis*); reduced stamens or staminodes large to minute; anthers elliptic to linear, opening by a longitudinal slit. *Pods* dehiscent or tardily dehiscent, woody or thin-valved. *Seeds* with short funicular aril-lobes.

Distribution — About 60 species in S and SE Asia.

KEY TO THE SPECIES

- 1a. Hypanthium 7–10 cm long 42. **B. sylvani**
- b. Hypanthium up to 4 cm long 2
- 2a. Buds small, globose, ovoid, ellipsoid, c. 5–10 mm long, or narrowly fusiform 10–12 by 2–3 mm; calyx splitting into 2–4(–5) ovate lobes, tardily caducous; anthers 1–3 mm long 3
- b. Buds large, c. 8–50 by 4–10 mm long, ovoid, ellipsoid, obovoid, fusiform or clavate; calyx splitting into 5 (rarely 4) finally free, strap-shaped lobes, sometimes early caducous; anthers (3–)4–25 mm long 11
- 3a. Ovary entirely glabrous; hypanthium long, thin, tubular, 10–20 mm long, longer than bud 4
- b. Ovary hairy or puberulous; hypanthium short, turbinate or tubular, 2–6 mm long, shorter than or equal to bud 5
- 4a. Lamina deeply divided nearly to the base; hypanthium c. 20 mm long; pod small, c.12 by 1.5 cm 17. **B. corymbosa**
- b. Lamina divided 1/3–1/2; hypanthium 10–15 mm long; pod large, 18–25 by 3–5.5 cm 27. **B. glauca**
- 5a. Claw of petals distinct, 10–25 mm long, longer than or equal to limb 6
- b. Claw of petals indistinct or short, shorter than limb 7
- 6a. Bud ovoid-ellipsoid; petals with suborbicular limb 16. **B. bassacensis**
- b. Bud narrowly fusiform; petals with lanceolate limb 28. **B. gracillima**
- 7a. Lamina entire, emarginate or bifid; flowers bright yellow, orange to red 30. **B. integrifolia**
- b. Lamina bifid; flowers white, pinkish or yellowish 8
- 8a. Ovary hairy only on stipe and along the sutures 25. **B. glabrifolia**
- b. Ovary entirely hairy 9
- 9a. Partial inflorescence a lax raceme; pedicel filiform, finally reflexed; filament hairy 18. **B. crudiantha**
- b. Partial inflorescence a dense corymb; pedicel slender, not reflexed; filament glabrous 10

- 10a. Petals 10–22 mm long, claw distinct, limb obovate; style glabrous **24. *B. fulva***
- b. Petals 7–10 mm long, narrowly spatulate, claw indistinct; style hairy on lower part **19. *B. endertii***
- 11a. Bud including hypanthium fusiform, 4–5 cm long; stigma indistinct or small capitate; anthers 20–25 mm long; petals early caducous; inflorescence a narrow raceme, 20–40 cm long 12
- b. Bud ovoid, ellipsoid, obovoid or clavate, up to c. 3.5 cm long; stigma capitate, peltate, small to very large; anthers (3–)4–22 mm long, inflorescence a raceme, subcorymb or corymb 14
- 12a. Leaves 6–8 cm long, 9–11-nerved; petals subglabrous outside . **15. *B. audax***
- b. Leaves larger, 14–25 by 10–22 cm, 11–15-nerved; the petals densely hairy outside 13
- 13a. Bracts 15–25 mm long; stipe reddish pubescent **36. *B. praesignis***
- b. Bracts 2–3 mm long; stipe glabrous **26. *B. glabristipes***
- 14a. Petals recurved; filaments 5–6 cm; stipules large, \pm orbicular, 10–20 mm across **23. *B. ferruginea***
- b. Petals not recurved; filaments short or long; stipules smaller, if large then lanceolate 15
- 15a. Pedicels very short, 2–8 mm 16
- b. Pedicels longer, 10–70 mm 19
- 16a. Hypanthium long, 35–40 mm **31. *B. kostermansii***
- b. Hypanthium shorter, 4–10 mm 17
- 17a. Leaves small, 2–5 cm long, bifid 1/3–2/3; inflorescence axis \pm elongate, slender; petals sparsely hairy outside **33a. *B. merrilliana* var. *merrilliana***
- b. Leaves larger, (4–)5–8 cm long, bifid 1/4–1/2; inflorescence short, pyramidal, axis stout; petals densely hairy outside 18
- 18a. Leaves suborbicular, lower reddish velvety; the hypanthium cup-shaped, c. 5 mm long **37. *B. rahmatii***
- b. Leaves ovate-oblong, lower brownish woolly; the hypanthium tubular, 7–10 mm long **38. *B. ridleyi***
- 19a. Leaves entire **21. *B. excurrens***
- b. Leaves bifid 20
- 20a. Stipules large, lanceolate, 2–3 by 1 cm; sepals densely hairy both sides **22. *B. fabrilis***
- b. Stipules smaller; sepals glabrous or sparsely puberulous inside 21
- 21a. Stigma small, capitate, 1–2 mm across 22
- b. Stigma large, peltate, 3–5 mm diam. 29
- 22a. Leaves large, (8–)10–26 cm long, tip of lobes acute to acuminate 23
- b. Leaves smaller, 6–10 cm long, tip of lobes acute, subacute or obtuse 24
- 23a. Inflorescences with brownish pubescence; flowers white; filaments c. 35 mm **9. *B. hendersonii***

- b. Inflorescences ferrugineous pubescent; flowers yellow to scarlet; filament 5–7 mm **14. B. andersonii**
- 24a. Bud large, 2.5–3 cm long, with 10 prominent longitudinal ridges **40. B. steenisii**
- b. Bud smaller, up to 2 cm long, without ridges 25
- 25a. Base of hypanthium abruptly contracted to pedicel; petals ± hairy outside at median zone 26
- b. Base of hypanthium gradually tapering to pedicel; petals puberulous to densely hairy outside 27
- 26a. Leaves small, 3–5(–6) cm long; hypanthium 4–6 mm ... **33. B. merrilliana**
- b. Leaves larger, 6–10 cm long; hypanthium 6–10 mm **41. B. stipularis**
- 27a. Inflorescences an elongated raceme, axis stout with conspicuous scars of fallen pedicels; petals densely hairy outside **34. B. pachyphylla**
- b. Inflorescences a short raceme, corymb or subcorymb; petals puberulous to densely hairy outside 28
- 28a. Leaves ovate oblong, deeply divided, 1/2–2/3, lobes narrowly triangular **35. B. pauciflora**
- b. Leaves ovate to orbicular, divided 1/3–1/2, tips of lobes obtuse to acute, rarely acuminate **32. B. lingua**
- 29a. Buds usually 2–3.5 cm long; petals densely hairy outside **20. B. excelsa**
- b. Buds not over 1–2 cm long, rarely longer; petals glabrous to hairy outside 30
- 30a. Hypanthium narrowly tubular, tapering to pedicels, 10–35 mm **32. B. lingua**
- b. Hypanthium tubular, with ± truncate base, 5–15 mm 31
- 31a. Hypanthium dilated at base **39. B. semibifida**
- b. Hypanthium not or only faintly dilated at base 32
- 32a. Hypanthium ± urceolate, c. 5 by 4 mm . **39c. B. semibifida** var. **bruneiana**
- b. Hypanthium tubular, 10–15 by 1–3 mm **13. B. aherniana**

13. Bauhinia aherniana Perkins

Bauhinia aherniana Perkins, *Fragm. Fl. Philipp.* 1 (1904) 8; Merr., *Philipp. J. Sc., Bot.* 5 (1910) 45; Enum. Philipp. Flow. Pl. 2 (1923) 258. — *Phanera aherniana* (Perkins) de Wit, *Reinwardtia* 3 (1956) 448. — Type: *Merrill 1237* (A lecto; BM, K, NY, TI), Mindoro.

Bauhinia hallieriana Elmer, *Leafl. Philipp. Bot.* 2 (1910) 691. — Type: *Elmer 12172* (NY lecto; C, P, W), Philippines.

Bauhinia subglabra Merr., *Philipp. J. Sc., Bot.* 3 (1908) 230; Enum. Philipp. Flow. Pl. 2 (1923) 261. — *Phanera semibifida* var. *subglabra* (Merr.) de Wit, *Reinwardtia* 3 (1956) 469. — Type: *Foxworthy BS 821* (K lecto; NY), Palawan.

KEY TO THE VARIETIES

- a. Petals externally densely pubescent, rarely puberulous; stipe of ovary hairy **a. var. aherniana**
- b. Petals externally subglabrous; stipe glabrous **b. var. subglabra**

a. var. *aherniana**Bauhinia hallieriana* Elmer

Tendrilled *liana*; young branches rusty pubescent, soon glabrous. *Leaves*: stipules obovate-orbicular, pubescent on both surfaces, 3–5 mm across; lamina ovate to orbicular, 6–8(–12) cm across, 11–13(–15)-nerved; bifid 1/3–1/2; apex of lobes obtuse; base cordate; upper surface glabrous, lower brownish pubescent to subglabrous. *Inflorescences* lateral and terminal, velvety brown corymbs to short racemes; pedicels 1.5–3.5 cm; bracts oblong-acute, c. 7 mm; bracteoles subulate, 5 mm, inserted below the middle of the pedicel. *Buds* clavate-ellipsoid, \pm apiculate, distinctly contracted at base towards the hypanthium. *Hypanthium* tubular, 10–15 mm by 1–3 mm, not or only slightly dilated at base, abruptly constricted towards the slender pedicel, faintly striate. *Calyx* splitting into 5 free, reflexed sepals, 15–20 mm long. *Petals* creamy white turning yellow, unequal, elliptic with a distinct claw, densely silky, brown pubescent outside, rarely puberulous, 25–35 by 7–13 mm including the 4–5 mm long claw. *Stamens* 3 fertile; filaments 2–3 cm, glabrous; the anthers oblong elliptic, 7–9 mm; staminodes 2 or 3, subulate. *Ovary*, stipe and style entirely brownish silky hairy, rarely glabrous below the stigma; stipe c. 7 mm; ovary c. 10 mm; style 5 mm; stigma peltate, c. 3 mm in diam. *Pods* strap-shaped, c. 15 by 3 cm with a 7 mm long beak. *Seeds* \pm orbicular, c. 12 mm.

Distribution — *Malesia*: Philippines (Luzon, Mindoro, Leyte).

Habitat — Open localities at lower altitudes, up to 650 m.

Notes — 1. Var. *aherniana* is closely related to *Bauhinia semibifida* and *B. lingua*; some specimens even tend to be intermediate between the two species. We do, however, maintain *B. aherniana* as a species because of the hypanthium characters.

2. This variety is known from four collections from Mindoro, two from Romblon, one from Leyte, and one from Laguna de Bay (Manila).

b. var. *subglabra* (Merr.) K. & S.S. Larsen

Bauhinia aherniana Perkins var. *subglabra* (Merr.) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 661. — *Bauhinia subglabra* Merr. — *Phanera semibifida* var. *subglabra* (Merr.) de Wit.

Large climber up to 20 m. Flowers cream coloured turning jade green to yellow green, intensely fragrant. Deviates from var. *aherniana* in the glabrous to subglabrous leaves, the externally subglabrous petals, and the glabrous stipe.

Distribution — *Malesia*: Borneo (Sabah), Philippines (Palawan).

Note — There are four collections from Palawan, all around Puerto Princesa, and one from Mt Pulgar. On the specimen from Sabah (Lahad Datu) the flowers are described as red. This is not observed in any other specimen in this group (i.e. *Bauhinia semibifida*, *B. lingua*, *B. aherniana*). Either it is a mistake or the plant represents an undescribed taxon. Hypanthium and ovary characters are matching those of var. *subglabra* well.

14. *Bauhinia andersonii* K. & S.S. Larsen

Bauhinia andersonii K. & S.S. Larsen, Nord. J. Bot. 2 (1982) 330. — Type: *Unesco Limest. Exped.* 653 (K holotype; L, SING), Kelantan.

Tendrilled woody climber; young branches ferrugineous pubescent, later glabrous. *Leaves*: stipules early caducous (not seen); petiole 3–14 cm, ferrugineous pubescent to subglabrous; lamina ovate to suborbicular, 8.5–26 by 8–23 cm; 11–15(–17)-nerved; bifid 1/3–1/2 with narrow sinus; tip of lobes acute, slightly falcate, base cordate; upper surface glabrous, lower ferrugineous pubescent to subglabrous. *Inflorescences* lateral and terminal, silky ferrugineous panicles on stout branches; partial inflorescences corymbs, later elongating to racemes, up to 26 cm; pedicels 1–3 cm; bracts lanceolate, 7–10 mm, early caducous; bracteoles linear, 3–5 mm, inserted about the middle of the pedicel or just below the hypanthium. *Buds* narrowly obovoid with pointed apex, 11–15 mm. *Hypanthium* narrowly infundibuliform, only slightly broader than the pedicel, 10–13 mm long. *Calyx* splitting into 2–5, later reflexed, strap-shaped segments, pubescent outside, glabrous inside. *Petals* yellow to scarlet, unequal, ferrugineous-villous outside, glabrous inside, posterior one often smallest, lanceolate, short-clawed; 4 remaining ones circular to obovate, tapering towards the base, 20–30 mm long including the 3–8 mm long claw. *Stamens* 3 fertile; filaments glabrous to sparsely hairy, 5–7 mm; anthers glabrous, as long as filaments; staminodes absent (or 1 minute). *Ovary* ferrugineous pubescent, 6–8 mm long, on a 2–4 mm long, pubescent stipe; style hairy, 10–13 mm, in bud S-shaped, straightening during anthesis; stigma capitate, c. 2 mm; ovules 6–11. Young *pods* strap-shaped, ferrugineous tomentose, c. 18 cm long, broadest towards apex, c. 4 cm; beak c. 1 cm; ventral sutures raised. Mature *pods* and *seeds* not known. — **Fig. 5.**

Distribution — *Malesia*: endemic to the Malay Peninsula (Kelantan and Pahang).

Habitat — Limestone mountains at altitudes about 400 m.

15. *Bauhinia audax* (de Wit) Cusset

Bauhinia audax (de Wit) Cusset, *Adansonia*, n.s. 6 (1966) 278; Wunderlin, Larsen & Larsen, *Biol. Skr. Dan. Vid. Selsk.* 28 (1987) 20. — *Phanera audax* de Wit, *Reinwardtia* 3 (1956) 441. — Type: *Ridley's Coll. s.n.*, 1892 (SING holotype), G. Pulau.

Bauhinia calycina Ridley, *J. As. Soc. Str. Br.* 61 (1912) 3, nom. illeg., non Pierre ex Gagnep. 1912; *Fl. Malay Penins.* 1 (1922) 626, excl. syn.; Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 311.

Tendrilled climber, young parts ± appressed puberulous, later glabrous. *Leaves*: stipules very early caducous (not seen), scars small; petiole 3–4.5 cm long, slender; lamina broadly ovate to suborbicular, 6–8 cm diam., rarely larger; 9–11-nerved; bifid 1/3–1/2 with rather wide sinus; tip of lobes obtuse, base deeply cordate; upper surface glabrous, lower glabrous except for a few hairs on the nerves. *Inflorescences* elongate, stout, terminal racemes up to 40 cm with 10–15 flowers; axis reddish-brown puberulous; pedicels stout, 1.7–3 cm long, longitudinally furrowed, puberulous; bracts ovate-lanceolate, c. 8 mm long, rusty puberulous, early caducous; bracteoles linear, smaller, inserted about the middle of the pedicel. *Buds* including hypanthium fusiform, ridged, appressed rusty puberulous, 4–5 by 1 cm. *Hypanthium* campanulate, slightly angulate, c. 1.5–2 cm

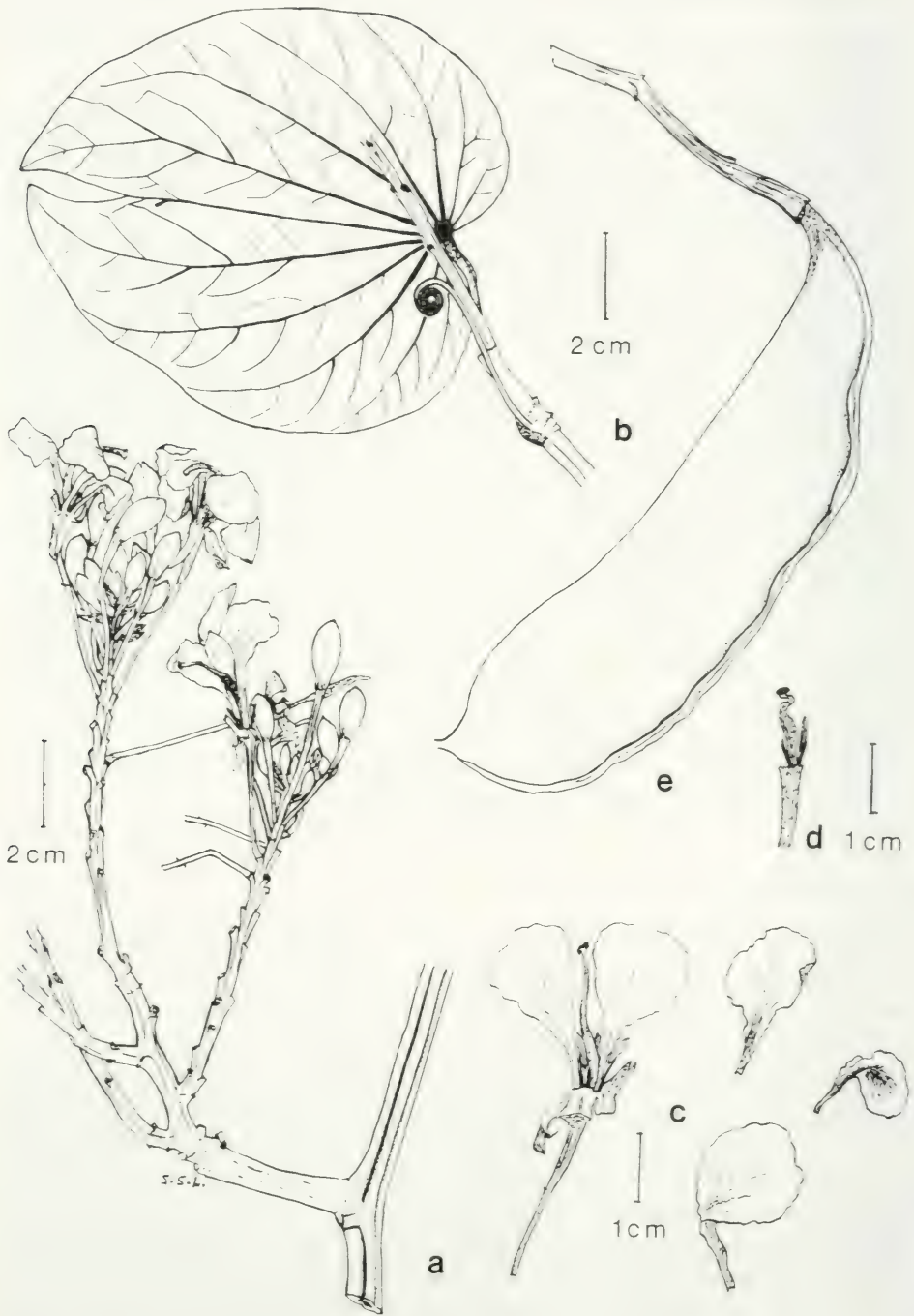


Fig. 5. *Bauhinia andersonii* K. & S.S. Larsen. a. Flowering twig; b. leaf; c. floral parts; d. pistil; e. fruit (a, d–h: *Unesco Limest. Exp.* 653; b, c: *Loh Hoy Shing FRI* 17178). Drawing S.S. Larsen.

long. *Calyx* splitting into 5 free sepals, fleshy, strap-shaped, acute, 2.5–3.5 cm. *Petals* greenish, of the same length as the sepals, narrowly lanceolate, gradually narrowing towards the claw, subglabrous, early caducous. *Stamens* 3 fertile; filaments stout, as long as sepals; anthers 2–2.5 cm long; staminodes 2, c. 1.5 cm. *Ovary* 1.5–2 cm, on a short, thick, 7–10 mm long stipe, all rusty pubescent as the curved style, 1.5–2 cm; stigma indistinct. *Pods* dehiscent, strap-shaped, up to 20 by 6 cm, beaked. *Seeds* 4–7, flattened, orbicular, c. 2 cm diam.

Distribution — *Malesia*: southern part of the Malay Peninsula (Selangor, Negri Sembilan, Malacca, Johore).

Habitat — Evergreen forests at low altitudes, not collected above 100 m.

16. *Bauhinia bassacensis* Gagnep.

Bauhinia bassacensis Pierre ex Gagnep., Not. Syst. 2 (1912) 168; Gagnep. in Fl. Indo-Chine 2 (1913) 124; Craib, Fl. Siam. Enum. 1 (1928) 516; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 7; in Fl. Camb., Laos & Vietnam 18 (1980) 175, pl. 31/1–3; in Fl. Thailand 4 (1984) 29, f. 7/1–3; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 20. — *Phanera bassacensis* (Pierre ex Gagnep.) de Wit, Reinwardtia 3 (1956) 472; Backer & Bakh. f., Fl. Java 1 (1964) 534; Hô, Illus. Fl. S. Viêt-nam, ed. 2, 1 (1970) 816, f. 2060. — Type: *Harmand 1240* (P holo), Laos.

Bauhinia viridiflora Backer, Bull. Jard. Bot. Buitenzorg III, 2 (1920) 323. — Type: *Backer 8801* (BO lecto; BR, BRIS, CAL, K, SING, U), Java.

Bauhinia sanitwongsei Craib, Kew Bull. (1924) 94; Fl. Siam. Enum. 1 (1928) 528, incl. var. *glauca* Craib, l.c. — Type: *Kerr s.n.* (K lecto; ABD), cult.

Bauhinia detergens Craib, Kew Bull. (1927) 388. — Type: *Winit 1240* (K lecto; ABD), Thailand.

Bauhinia longipes Merr., Univ. Calif. Bot. Publ. 15 (1929) 102. — Type: *Elmer 21435* (US lecto; B, BR, C, K, U), Sabah.

Bauhinia fleuryi Gagnep., Bull. Mus. Nat. Hist. Nat. Paris II, 24 (1952) 312. — Type: *Fleury in Chevalier 31784* (P holo), Cambodia.

Bauhinia bracteata auct. non (Graham ex Benth.) Baker: Ridley, J. Fed. Mal. St. Mus. 7 (1919) 40; Fl. Malay Penins. 1 (1922) 634.

KEY TO THE VARIETIES

- a. Fertile stamens pubescent, 1.5–2 cm long; petals yellowish green or two of them purple-blotched **a. var. *bassacensis***
- b. Fertile stamens sparsely hairy at base to glabrous, 2.5–3.5 cm long; petals all or only two purple-blotched and with purple veins **b. var. *backeri***

a. var. *bassacensis*

Bauhinia sanitwongsei Craib — *Bauhinia detergens* Craib — *Bauhinia fleuryi* Gagnep. — *Bauhinia bracteata* auct.

Large tendrilled climber; young branches rusty tomentose, later glabrous. *Leaves*: stipules auriculate, up to 6 mm diam., caducous; petioles glabrescent, 2–7 cm; lamina ovate, up to 19 by 13 cm, 9–13-nerved; bifid 1/2–2/3 with narrow sinus; tip of lobes triangular obtuse to acuminate; base cordate to truncate; upper surface glabrous, lower

brownish tomentose to glabrescent. *Inflorescences* lateral or terminal, many-flowered, broad racemes or panicles; axis rusty tomentose to glabrescent; pedicels up to 7 cm; bracts linear-lanceolate, tomentose, up to 8 mm; bracteoles similar but smaller, inserted near the middle of the pedicel; pedicels up to 7 cm. *Buds* ovoid-ellipsoid, brownish tomentose, c. 7 mm. *Hypanthium* c. 1 mm. *Calyx* during anthesis splitting into 2 segments forming right angles with the pedicels, 5–8 mm long. *Petals* pubescent, yellowish green, sometimes two of them purple-blotched at tip, subequal, blade deltoid, narrowly ovate to suborbicular with crenulate margin, 10 by 7 mm; claw 10–25 mm long. Fertile *stamens* 2 (rarely 3), filaments c. 2 cm, pubescent; anthers 1–2 mm; reduced stamens 7, 3–9 mm long; staminode 1, short, filiform, between the stamens. *Ovary* stipitate, brownish pilose; style 7–10 mm, glabrous towards the small stigma. *Pods* glabrescent, smooth; 9 by 3 cm. *Seeds* 3–5, flattened, orbicular, c. 1 cm diam.

Distribution — Thailand, Laos, Cambodia, Vietnam and northern Peninsular Malaysia (Kedah, Kelantan).

Habitat — Common liana in evergreen and mixed deciduous forests.

b. var. *backeri* (de Wit) S.S. Larsen

Bauhinia bassacensis Gagnep. var. *backeri* (de Wit) S.S. Larsen, Grana 14 (1975) 122 (sphalm. '*bakeri*') —

— *Phanera bassacensis* var. *backeri* de Wit, Reinwardtia 3 (1956) 472. — *Bauhinia viridiflora* Backer, Bull. Jard. Bot. Buitenzorg III, 2 (1920) 323. — Type: *Backer 8801*.

Bauhinia longipes Merr., Univ. Calif. Bot. Publ. 15 (1929) 102.

Deviates from the typical variety by the narrower, greyish-pubescent buds and the longer, sparsely hairy to glabrous filaments of the fertile stamens and by the purple-blotched petals, usually all of them but sometimes only two of them.

Distribution — *Malesia*: Borneo (Sabah), W Java.

17. *Bauhinia corymbosa* Roxb.

Bauhinia corymbosa Roxb. [Hort. Beng. (1814) 31] ex DC., Mem. 13 Leg. (1825) 487, f. 70; Prodr. 2 (1825) 515; Wall., Cat. (1831) 5788; Roxb., Fl. Ind., ed. Carey, 2 (1832) 329; Korth., Kruidk. (1841) 92; Miq., Fl. Ind. Bat. 1, 1 (1855) 69; Larsen & Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 182; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19. — *Phanera corymbosa* (Roxb. ex DC.) Benth. in Miq., Pl. Jungh. (1852) 264; de Wit, Reinwardtia 3 (1956) 488. — Type: *Wallich 5788* (K lecto), Bot. Gard. Calcutta.

Bauhinia scandens auct. non L.: Burm., Fl. Ind. (1768) 94.

Slender, tendrilled *liana*. Young branches reddish pubescent, later glabrous. *Leaves*: stipules linear, slightly falcate, pointed, 1.5–2 mm; petiole slender, glabrescent, 1–1.8 cm; lamina ovate, 2–3.5 by 2–4 cm; 7-nerved; bifid until 2/3–3/4 with very narrow sinus; tip of lobes obtuse; base truncate or slightly cordate; upper surface glabrous, lower sparsely reddish pubescent particularly along the nerves. *Inflorescences* terminal and lateral, c. 5 cm long, pyramidal or conical corymbs; axis reddish pubescent; bracts subulate, c. 2 mm; bracteoles similar but smaller, inserted in the lower half of the pedicel; pedicel slender, c. 1 cm. *Buds* ovoid, 5–7 mm, reddish pubescent. *Hypanthium* narrowly tubular, striate, c. 20 mm. *Calyx* splitting into 2–4(–5) ± reflexed segments.

Petals white, subequal, obovate, 10–13 mm long including the short claw, velutinous outside. Fertile *stamens* 3; filaments pink, glabrous, 10–13 mm; anthers 2–3 mm; staminodes 7: 2 between the fertile stamens very small, 5 short subulate, c. 4 mm, connate at base. *Ovary* pink, glabrous, shortly stipitate, 8–10 mm long including the very short style; stigma oblique, peltate. *Pods* narrowly oblong, straight or slightly falcate, dehiscent, up to 12 by 1.5 cm, smooth, glabrous, glossy. *Seeds* 15 or more, oblong, 7 by 3.5 mm.

Distribution — A Chinese species also found in N Vietnam. In *Malesia* introduced as an ornamental.

18. *Bauhinia crudiantha* (de Wit) Cusset

Bauhinia crudiantha (de Wit) Cusset, *Adansonia*, n.s. 6 (1966) 279. — *Phanera crudiantha* de Wit, *Reinwardtia* 3 (1956) 484. — Type: *Kloss SF 18739* (SING holo; BR, L, NY), Sabah.

Large, tendrilled *climber*; young branches rusty tomentose, tardily glabrescent. *Leaves*: stipules not seen; petioles 5–8 cm, rusty tomentose; lamina broadly ovate to orbicular, 11–17 by 10–15 cm; 11–13-nerved; bifid 1/4–1/3 with broad sinus; tip of lobes acuminate; base deeply cordate; upper surface sparsely brownish-pubescent particularly along the nerves, lower reddish brown puberulous mainly on the nerves. *Inflorescences* lax, lateral, simple or compound, elongate, many-flowered racemes; axis rusty tomentose; pedicels 2–3 cm, filiform, pubescent, after anthesis reflexed; bracts subulate, 2–3 mm; bracteoles filiform, 1–2 mm, inserted near the middle of the pedicel. *Buds* ovoid with pointed apex, c. 5 mm long, brownish tomentose. *Hypanthium* tubular, 4–5 mm long, striate, pubescent. *Calyx* splitting into 2 (or 3) finally reflexed lobes. *Petals* subequal, white, narrowly obovate, 7–10 mm long with crenate-undulate margin, gradually narrowed towards the claw; outside densely appressed ferrugineous hirsute along the middle, inside hairy towards base. *Stamens* 3 fertile; filaments 6–10 mm, densely hirsute in lower half; anthers ellipsoid, 1.5–2 mm; staminodes 1 (or 2), filiform, minute, c. 1 mm. *Ovary* light rusty brown, woolly hairy, subsessile, c. 4–5 mm; style as long as ovary, hirsute almost to the stigma; stigma peltate. *Pods* rusty velvety, 15–40 by 5–8 cm (see also Note 1). *Seeds* 2–3, compressed, oval, c. 2.5 cm diam.

Distribution — *Malesia*: Borneo. Only known from the type collection from Sandakan (and see Note 1).

Habitat — Lowland evergreen forest.

Notes — 1. Two specimens from Sarawak, 1st Div., one in flower from Bau and one in fruit from Datu, are closely related to this species; the inflorescence, however, is shorter and the filaments glabrous; the fruiting specimen has 2 pods, rusty brown, c. 14 by 5 cm. A collection mentioned by de Wit (l.c.), *Cuadra A 2130*, from Kinabatangan-besar consists of leaves, old inflorescence axis and a very large, velutinous pod (not attached to the specimen!) of 40 by 8 cm. We have studied this material at K and SING (several sheets) and found that, even in spite of the very large pod, it undoubtedly belongs here.

2. *Bauhinia crudiantha* is evidently a rare species not yet fully understood. It is closely related to *B. endertii* and *B. fulva* from which it mainly deviates in the inflorescence

structure, the insertion of the bracteoles, the hypanthium, and the filament hairy in the lower part. De Wit (l.c.) suggests that it is close to *B. ornata* Kurz ('*Phanera rufa* Benth. '); this species, belonging to the northern hemispheric monsoon region, has only a superficial resemblance to *B. crudiantha*.

19. *Bauhinia endertii* K. & S.S. Larsen

Bauhinia endertii K. & S.S. Larsen, Taxon 28 (1979) 592; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19. — *Phanera argentea* de Wit, Reinwardtia 3 (1956) 484. — *Bauhinia argentea* (de Wit) Cusset, Adansonia, n.s. 6 (1966) 279, comb. illeg., non Chiov. (1915). — Type: *Ender* 2399 (BO holotype, L, SING), Kalimantan.

Large tendrilled climber; the young branches silky reddish brown, later glabrous. *Leaves*: stipules lanceolate, reddish woolly outside, inside subglabrous, c. 4 mm long, early caducous; petioles 3–5 cm, rusty tomentose; lamina ovate to orbicular, 4–10 by 4–12 cm; 11–13-nerved; bifid 1/4–1/3 with broad sinus; tip of lobes rounded to acute or acuminate; base deeply cordate; upper surface sparsely yellowish brown to coppery pubescent, particularly along the nerves, lower reddish brown puberulous, mainly on the nerves. *Inflorescences* terminal and lateral, compound or simple, dense corymbs; pedicels up to 2 cm, greyish pubescent; bracts narrow lanceolate acuminate, 4–6 mm, outside appressed hirsute; bracteoles subulate, 2–4 mm, inserted 1–3 mm below the hypanthium. *Buds* ovoid, with pointed apex, 4–5 mm, greyish pubescent. *Hypanthium* short, c. 2 mm. *Calyx* splitting into 2 or 3, later often 5 free sepals, c. 7 mm long, reflexed. *Petals* yellowish white, narrowly oblong, subequal, 7–10 mm long, margin crenate-undulate, gradually narrowing into the indistinct, greenish claw, outside densely appressed hirsute, inside glabrous. *Stamens* 3 fertile; filaments 5–6 mm, glabrous; anthers red, c. 2 mm; staminodes 2, minute, subulate. *Ovary* appressed hirsute, subsessile, c. 3 mm; style hirsute; stigma peltate. *Pods* broadly oblong, c. 17 by 5.5 cm; young pods with light brown indumentum; mature pods almost glabrous (see Note 1). *Seeds* 3 or 4, flat, oval, c. 2 cm diam.

Distribution — *Malesia*: Borneo (Sabah, Sarawak, W and E Kalimantan).

Habitat — Lowland evergreen forests, often along rivers.

Notes — 1. This species is closely related to *Bauhinia fulva*; we have kept it at specific level as we find it fairly well distinguished by the small, more gracile floral structures, the hairy style and several quantitative characters. Only one specimen has a mature pod, a very old one; if the pod really is glabrous this is another good character distinguishing it from *B. fulva*.

2. In this species there is a wide variation in the indumentum of the leaves and inflorescences from densely hairy to almost glabrous. Also the shape of the leaves varies considerably. One specimen, *Argent & Coppins* 1148 (AAU, E) from Mt Mulu has the leaves glabrous or nearly so and the tip of the lobes caudate; the inflorescence is almost glabrous, the flowers somewhat larger, and the style subglabrous. When more material from Mt Mulu is available, it may be established as a separate variety.

20. *Bauhinia excelsa* (Miq.) Prain

Bauhinia excelsa (Blume ex Miq.) Prain, J. As. Soc. Beng. 66, ii (1897) 502. — *Phanera excelsa* Blume ex Miq., Fl. Ind. Bat. 1, 1 (1855) 62; de Wit, Reinwardtia 3 (1956) 451. — Type: *Korthals s.n.* (L holo; BR), Kalimantan.

Bauhinia megalantha Merr., Philipp. J. Sc., Bot. 11 (1916) 81. — *Phanera excelsa* var. *megalantha* (Merr.) de Wit, Reinwardtia 3 (1956) 453. — *Bauhinia excelsa* var. *megalantha* (Merr.) K. & S.S. Larsen, Nord. J. Bot. 2 (1982) 332. — Type: *Hose 163* (holo n.v.; E, K), Sarawak.

Phanera excelsa var. *aurora* de Wit, Reinwardtia 3 (1956) 452. — Type: *Clemens 28112* (BO holo; L), Sabah.

Bauhinia ferruginea auct. non Roxb.: Korth., Kruidk. (1841) 90; Miq., Anal. Bot. 1 (1850) 11.

KEY TO THE VARIETIES

- a. Leaves 5–10 cm across, when adult glabrescent below; buds ellipsoid-clavate; the hypanthium \pm striate, 12–15 mm long **a. var. *excelsa***
- b. Leaves 8–16 cm across, when adult pubescent below; buds ovoid; the hypanthium smooth, 5–7 mm long **b. var. *aurora***

a. var. *excelsa*

Bauhinia megalantha Merr.

Large tendrilled climber; young branches woolly brown pubescent, later glabrous. *Leaves*: stipules orbicular to oblong, rarely acutish, silky brown hirsute outside, thinly pubescent inside, early caducous, c. 8 by 5 mm; petiole slender, brownish pubescent, (1–)2–5 cm; lamina ovate or obovate to suborbicular, 5–10 cm across, bifid 1/4–1/3, tip of lobes rounded, base more or less cordate, 9–11-nerved; upper surface glabrous, lower thinly rusty pubescent when young, later glabrescent. *Inflorescences* terminal and lateral, usually narrow racemes, 10–25 cm long; axis and other floral parts outside brownish pubescent; pedicels 2.5–5 cm; bracts narrow lanceolate, 8–10 mm, early caducous; bracteoles similar but smaller, inserted below the middle of the pedicel. *Buds* densely brownish tomentose, ellipsoid to clavate, \pm apiculate, (1.5–)2–3.5 cm, with 5 longitudinal grooves. *Hypanthium* broadly tubular, usually conspicuously striate, 10–18 mm long, slightly dilated on one side at base. *Calyx* early splitting into 5 reflexed, strap-shaped sepals, 2–3.5 cm, glabrous inside. *Petals* creamy-white turning yellow, subequal, blade elliptic to narrow obovate to spatulate, gradually or abruptly narrowed towards the fleshy claw, (20–)35–50 by (5–)10–20 mm, outside densely rusty silky hairy, inside glabrous except for the 5–10 mm long claw. *Stamens* 3 fertile; filaments pink, 4–5 cm, glabrous; anthers red, elliptic-oblong, 10–20 mm; staminodes 2, filiform, 10–20 mm. *Ovary* 10–15 mm, rusty tomentose, stipe 10–15 mm; style thick, 15–20 mm, tomentose; stigma green, large peltate, oblique, c. 5 mm. *Pods* oblong lanceolate, 13–25 by 4–5 cm, with a 1 cm long beak; pubescent when young, later glabrous. *Seeds* (3–)4–6, flat, orbicular, 1.5–2 cm across.

Distribution — *Malesia*: widely distributed on Borneo.

Habitat — Occurring from the lowlands up to 1500 m altitude; the highest records are from Mt Kinabalu.

Uses — As a native medicine.

Notes — 1. *Bauhinia excelsa* is particularly polymorphous in the size and shape of the floral parts. De Wit (l.c.) writes that Merrill's *Bauhinia megalantha* cannot be maintained at species level, but may be kept as a variety of *B. excelsa* mainly on account of its larger flowers; this view has been even clearer with the more ample material we have had available. It is evident that there is a gradual variation in the size of the floral parts; furthermore the size of the sepals and petals of the type specimen of *B. megalantha* does hardly deviate from the size of the type of *B. excelsa*. On the other hand there are small-flowered specimens of *B. excelsa* showing some resemblance with *B. semibifida*, but the petals are always densely hairy on the outer side; their measures are given in parenthesis in the description above.

2. Petals may vary in colour from yellow to red (in different stages of development) or white with pink stripes; most plants, however, seem to have flower colours as indicated above.

b. var. *aurora* (de Wit) K. & S.S. Larsen

Bauhinia excelsa (Blume ex Miq.) Prain var. *aurora* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 2 (1982) 332. — *Phanera excelsa* Blume ex Miq. var. *aurora* de Wit, Reinwardtia 3 (1956) 452.

Similar to var. *excelsa* but with petioles longer, tardily glabrescent; leaves larger, lamina 8–16 cm across, 11–13-nerved, tip of lobes acute to subacute; lower surface pubescent. Bracts carinate, 3–4 mm; bracteoles very small. Buds ovoid, abruptly narrowed towards the hypanthium which is tubular, short, 5–7 mm long, smooth; sepals c. 2.5 cm long; petals c. 3 cm long with a 5–7 mm long claw; filaments 2.5–3 cm; staminodes c. 5 mm. Pods unknown. — **Fig. 6.**

Distribution — *Malesia*: endemic to N Borneo and probably restricted to Mt Kinabalu and surrounding mountains.

Habitat — Montane, found between 1300 and 1500 m.

21. *Bauhinia excurrens* Stapf

Bauhinia excurrens Stapf, Trans. Linn. Soc. Lond. II, 4 (1894) 143. — *Phanera semibifida* (Roxb.) Benth. var. *excurrens* (Stapf) de Wit, Reinwardtia 3 (1956) 468. — Type: *Haviland 1382* (K holo).

Tendrilled climber; young branches glabrous. *Leaves*: stipules early caducous (not seen); petioles glabrous, 3–5 cm; lamina entire, glabrous, 9–11 by 6–7 cm; 9–11-nerved; apex acuminate to caudate; upper surface glabrous, lower sparsely appressed puberulous to subglabrous. *Inflorescences* of lateral and terminal, few-flowered corymbs; pedicels c. 5 cm, almost glabrous; bracts early caducous (not seen); bracteoles subulate, 2–3 mm, inserted below the middle. *Buds* clavate-ellipsoid, apiculate, glabrous or nearly so, truncate at base. *Hypanthium* c. 1 cm, glabrous, striate, not or only faintly dilated at base, distinctly contracted above the pedicel. *Calyx* splitting into 5 glabrous, reflexed sepals.

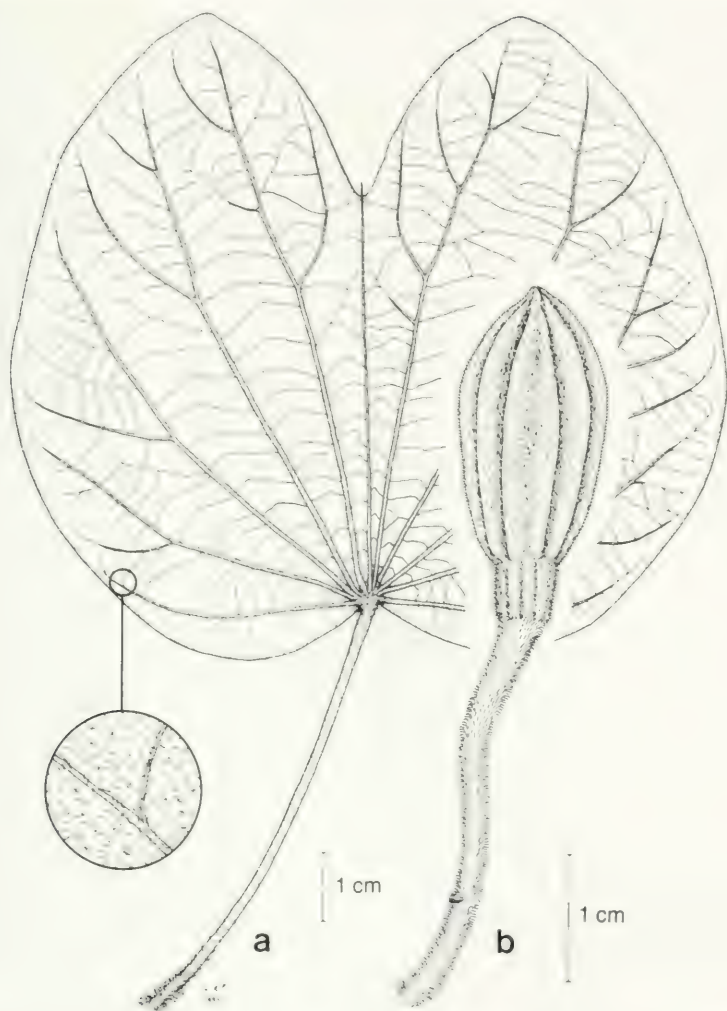


Fig. 6. *Bauhinia excelsa* (Miq.) Prain var. *aurora* (de Wit) K. & S.S. Larsen. a. Leaf and detail of lower surface; b. flower bud (a: Clemens 51709; b: Clemens 28112). Drawing H.Æ. Pedersen.

Petals white (?), lanceolate with a short, distinct claw; glabrous or subglabrous on both sides, c. 2 cm including the claw. *Stamens* 3 fertile, not exerted; filaments c. 1.5 cm; anthers elliptic, 1–2 cm; staminodes 2 or 3, c. 2 mm with minute anthers. *Ovary* densely brownish silky hairy, on a short stipe; style short, silky hairy; stigma peltate, c. 5 mm across. *Pods* unknown.

Distribution — *Malesia*: Borneo (only known from Mt Kinabalu, 600–700 m altitude).

Note — This is one of several species of *Bauhinia* endemic to Mt Kinabalu. De Wit, l.c., referred it to *B. semibifida* as a variety. We have maintained it as a distinct species because of the entire leaves, unique in this group.

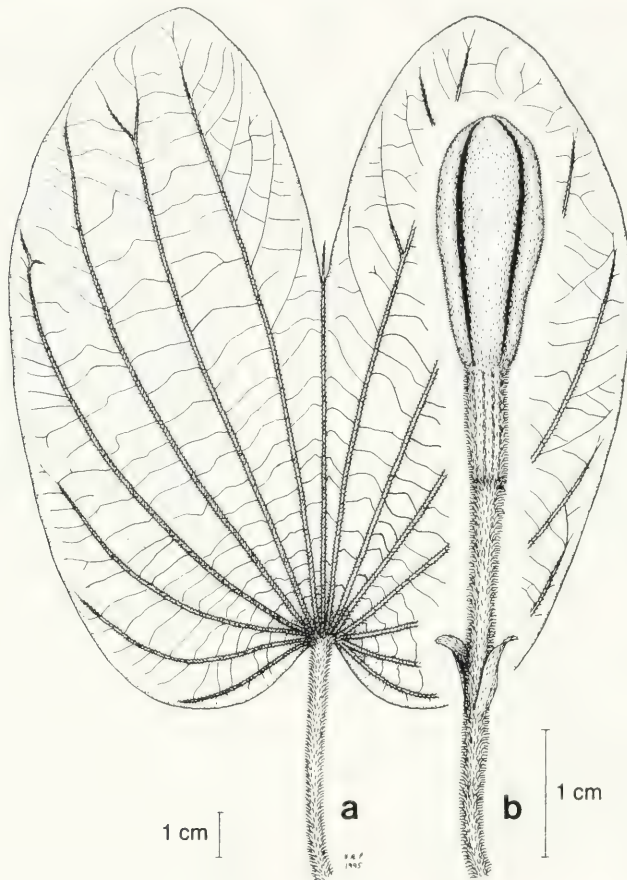


Fig. 7. *Bauhinia fabrilis* (de Wit) K. & S.S. Larsen. a. Leaf, lower surface; b. flower bud (Anthony A 765). Drawing H.Æ. Pedersen.

22. *Bauhinia fabrilis* (de Wit) K. & S.S. Larsen

Bauhinia fabrilis (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 661. — *Phanera riedelii* (Baker f.) de Wit var. *fabrilis* de Wit, Reinwardtia 3 (1956) 464. — Type: Anthony A 756 (L holo; K, KEP, SING), Sabah.

Large, woody, tendrilled *climber*; young branches quadrangular, reddish brown woolly hairy, particularly along the edges. *Leaves*: stipules large, lanceolate to slightly falcate, acuminate, 2–3 by c. 1 cm, when young outside densely rusty silky hairy, soon glabrescent, early caducous; petiole woolly pubescent, stout, 5–8 cm long; lamina broadly ovate, bifid 1/3–1/2; tip of lobes obtuse to acuminate; base deeply cordate, 15–22 by 14–16 cm; 15–17-nerved; upper surface glabrous, shining, lower sparsely pubescent to almost glabrous except for the nerves. *Inflorescences* when young corymbose, axis eventually lengthening, up to 15 cm (or longer?), rusty tomentose, stout; pedicels 3–4 cm, rusty tomentose; bracts ovate-oblong, acute, 10–15 by 5–8 mm, silky hairy;

bracteoles narrowly oblong, 8–12 mm, inserted just below or near the middle of the pedicels. *Buds* clavate, 2–2.5 cm, furrowed, densely brownish silky pubescent. *Hypanthium* tubular, tapering towards the pedicel, faintly striate (not dilated), with cuneate base, 15–20 mm long. *Calyx* splitting into 5 reflexed, strap-shaped, acute sepals, densely hairy on both sides, 20–25 by 3–4 mm. *Petals* white to yellow, spatulate, c. 2 cm long, densely brownish silky hairy outside, almost glabrous inside, gradually narrowed towards the 5–7 mm long claw. *Stamens* 3 fertile; filaments 4–5 cm long, glabrous; anthers 8–10 mm long; staminodes 2. *Ovary* reddish brown silky pubescent, c. 10 mm, stipe 5–7 mm long, hairy as ovary; style c. 5 mm long, glabrous towards the medium-sized, peltate stigma. *Pods* unknown. — **Fig. 7.**

Distribution — *Malesia*: Borneo (Sabah: Crocker Range).

Habitat — Primary forests at low altitude.

Uses — Used for weaving coral fishers' fencing by the Sulaks, also for tying materials for floors in native houses.

Note — De Wit regarded this species as a variety of *Bauhinia riedelii* Baker, which we treat as a variety of *B. lingua*. *Bauhinia fabrilis* is a perfectly good species, morphologically as well as geographically separated from its nearest allies.

23. *Bauhinia ferruginea* Roxb.

Bauhinia ferruginea Roxb. [Hort. Beng. (1813) 90, nomen], Fl. Ind., ed. Carey, 2 (1832) 331; ed. Clarke (1874) 348; Baker in Hook. f., Fl. Brit. India 2 (1878) 283, excl. var. 2; Prain, J. As. Soc. Beng. 66, ii (1897) 184; Ridley, Fl. Malay Penins. 1 (1922) 628. — *Phanera ferruginea* (Roxb.) Benth. in Miq., Pl. Jungh. (1852) 262; Miq., Fl. Ind. Bat. 1, 1 (1854) 62; de Wit, Reinwardtia 3 (1956) 453. — Type: Wallich Cat. 5776 (K neo; BR, L, P), Penang I.

Bauhinia griffithiana (Benth.) Prain, J. As. Soc. Beng. 66, ii (1897) 183; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 311. — *Phanera griffithiana* Benth. in Miq., Pl. Jungh. (1852) 263; Miq., Fl. Ind. Bat. 1, 1 (1854) 65; de Wit, Reinwardtia 3 (1956) 455. — *Bauhinia ferruginea* var. *griffithiana* (Benth.) Baker in Hook. f., Fl. Brit. India 2 (1878) 283. — Type: Griffith s.n., 1845 (K holo; BR), Malacca.

Bauhinia hullettii Prain, J. As. Soc. Beng. 66, ii (1897) 183. — *Phanera hullettii* (Prain) de Wit, Reinwardtia 3 (1956) 457. — Type: Curtis 784 (SING lecto; K), Penang I.

Bauhinia suffruticosa Ridley, Trans. Linn. Soc. II, 3 (1893) 295. — Type: Ridley 2606 (BM), Pahang.

Bauhinia stipularis auct. non Korth.: Merr., Contr. Arnold Arbor. 8 (1934) 73.

Large, tendrilled climber; branches glabrescent. *Leaves*: stipules orbicular to ovate-orbicular or reniform, foliaceous, glabrous to sparsely hairy mainly inside, 10–28 mm; petiole 2–4 cm; greyish pubescent when young, soon glabrous; lamina ovate-orbicular, 7–10 by 7–8 cm, 9–11-nerved; bifid 1/3; tip of lobes obtuse, base cordate; upper surface glabrous, lower minutely pubescent when young, soon glabrous; rarely pubescent on the nerves. *Inflorescences* terminal, corymbose to pyramidal racemes with a greyish to ferruginous tomentose axis; pedicels puberulous to almost glabrous, 1–2 cm long; bracts varying, usually ovate or lanceolate, 7–15 mm long; bracteoles narrower, lanceolate, inserted in the lower half of the pedicel. *Buds* ellipsoid-clavate, greyish to ferruginous pubescent to almost glabrous, c. 15 mm. *Hypanthium* 10–15 mm, striate with dilated base. *Calyx* early splitting into 5 reflexed sepals. *Petals* creamy-white turning yellowish, rarely pinkish red; densely woolly tomentose on the outer side, glabrous in-

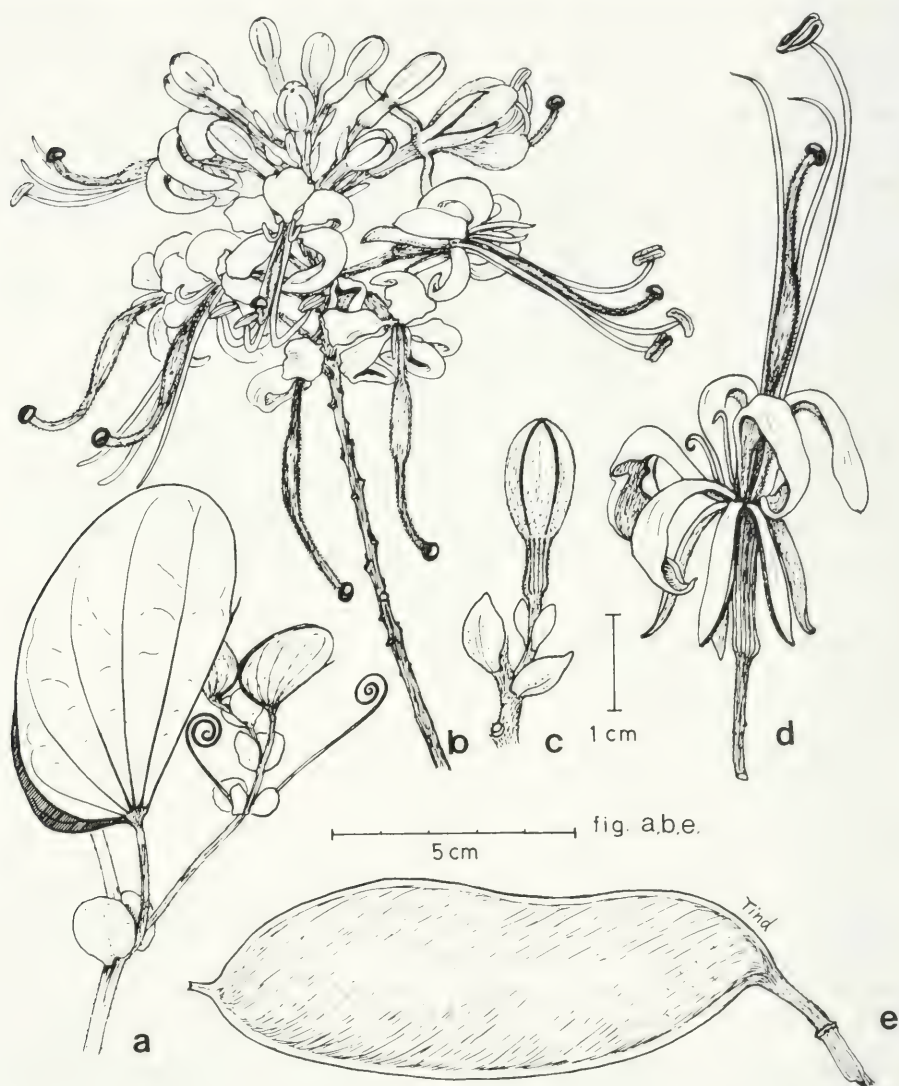


Fig. 8. *Bauhinia ferruginea* Roxb. a. Twig end with leaf; b. inflorescence; c. flower bud; d. flower; e. fruit (a, e: K. & S.S. Larsen 40324; b, d: Niyomdham 1870). Drawing K. Tind.

side, 3–4.5 cm long, lanceolate, claw short, indistinct; during anthesis margins of the petals becoming recurved, later the whole lamina recurved. *Stamens* 3 fertile, filaments pink, glabrous, 5–6 cm; anthers oblong, red, c. 5 mm; staminodes 2–3 (or more?), 12–20 mm, sometimes with minute anthers. Whole *gynoecium* densely ferrugineous tomentose, rapidly lengthening during anthesis; stipe 1–2 cm; ovary c. 1 cm; style 1–2.5 cm; stigma large, peltate. *Pods* dehiscent, woody, 15 by 4–6 cm, glabrous. *Seeds* few, 2–2.5 cm diam. — **Fig. 8.**

Distribution — From S Thailand throughout the Malay Peninsula and with a single record from eastern Sumatra.

Habitat — Most collections are from the lowlands (but found up to 800 m altitude), in forest margins, on sandy loam and on sandy soil in the peat swamp forests in southern Thailand.

Notes — 1. *Bauhinia ferruginea* is a well-defined species easily recognized by the unique character of the petals, first erect, then with recurved margins and finally the whole petal entirely curving downwards. Flower colours are by various collectors described from white or creamy turning yellowish, to pinkish. The petals are usually (always?) white to yellowish with age, the stamens pink to red and the anthers red.

2. We have found that the taxa '*ferruginea*' and '*griffithiana*' are difficult to distinguish; they are mainly based on presence or absence of stipules in herbarium material and on the colour of the indumentum. How much these characters are due to geographical and ecological conditions have still to be studied in nature. We have studied populations in southern Thailand of var. *ferruginea* and found that while the flowering branches shed the stipules, these were kept longer on young sterile shoots. Some collections from Penang (e.g. *Potts s.n.* in G) have smaller, ovate stipules on the tendrils, but apart from this we have not observed 'small falcate stipules' as mentioned by De Wit (l.c.). We have here chosen to maintain the two taxa as varieties as there are several examples that occur as transition forms; on the other hand, with our present knowledge, it seems that there is a difference in the distribution between var. *ferruginea* and var. *griffithiana*.

KEY TO THE VARIETIES

- a. Stipules on flowering shoots early caducous; indumentum of inflorescence axis and buds usually ferrugineous; bracts pubescent, lanceolate, 5–10 mm; bracteoles smaller **a. var. ferruginea**
- b. Stipules on flowering shoots tardily caducous; indumentum of inflorescence axis and buds usually greyish to light brown; bracts sparsely pubescent, ovate-carinate, 10–15 mm **b. var. griffithiana**

a. var. ferruginea

Bauhinia hullettii Prain — *Bauhinia stipularis* auct.

This seems to be the rarer variety, known only from S Thailand, Penang I., Perak, Trengganu, and Selangor, i.e. the northern part of the distribution area only.

b. var. griffithiana (Benth.) Baker

Bauhinia griffithiana (Benth.) Prain — *Phanera griffithiana* Benth. — *Bauhinia suffruticosa* Ridley.

This variety is found all over the Malay Peninsula, but not in S Thailand, and more-over in a single locality in E Sumatra.

24. *Bauhinia fulva* Korth.

Bauhinia fulva Blume ex Korth., Kruidk. (1841) 91; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 726; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19. — *Phanera fulva* (Blume ex Korth.) Benth. in Miq., Pl. Jungh. (1852) 262; Blume ex Miq., Fl. Ind. Bat. 1, 1 (1855) 66; de Wit, Reinwardtia 3 (1956) 476; Backer & Bakh. f., Fl. Java 1 (1964) 534. — Type: *Blume s.n.* (L holo; W), Java.

Bauhinia corymbosa auct. non Roxb.: Hassk., Flora 25, Beibl. (1842) 98.

Large climber; young branches densely woolly brown hairy, later glabrous. *Leaves*: stipules broadly lanceolate, densely woolly outside, less so inside, 5–10 mm long, caducous; petiole pubescent, 4–8 cm long; lamina broadly obovate to orbicular, up to 20 cm diam.; 11–13-nerved; bifid 1/3–1/2 with narrow sinus; tip of lobes rounded to acute; base deeply cordate; upper surface reddish brown puberulous when young, later glabrescent, lower woolly pubescent, indumentum gradually diminishing. *Inflorescences* terminal and lateral, simple or compound, dense corymbs; pedicels slender, up to 4 cm long, greyish brown woolly; bracts ovate, glabrous inside, woolly outside, c. 3 mm long; bracteoles minute, 1–2 mm, subulate, inserted just below the hypanthium. *Buds* ovoid with pointed apex, 5–9 mm, greyish brown pubescent. *Hypanthium* turbinate, 3–5 mm long. *Calyx* splitting into 2 or 3 or finally 5 free, reflexed sepals, 8–12 mm long. *Petals* white, obovate, unequal, 10–22 mm long including the 3–5 mm long greenish claw, outside appressed hirsute, inside glabrous. *Stamens* 3 fertile; filaments 10–18 mm, glabrous; anthers c. 2 mm long; staminodes 2, minute, subulate. *Ovary* 4–5 mm incl. the short stipe, reddish brown velvety; style slender, 6–7 mm, glabrous; stigma peltate. *Pods* dehiscent, c. 20 by 4–5 cm, velvety brown. *Seeds* 4–7, flat, orbicular, c. 2 cm diam.

Distribution — *Malesia*: Sumatra (2 sheets without locality), Java (several localities).

Habitat — Most often between 600 and 1000 m altitude, rarer at low altitudes; seems to prefer limestone.

Uses — Locally the roots are of medicinal use.

25. *Bauhinia glabrifolia* (Benth.) Baker

Bauhinia glabrifolia (Benth.) Baker in Hook. f., Fl. Brit. India 2 (1878) 281, excl. *Helper* 1879 (& '1789'); Larsen & Larsen, Thai For. Bull., Bot. 13 (1980) 37; in Fl. Thailand 4 (1984) 43; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19. — *Phanera glabrifolia* Benth. in Miq., Pl. Jungh. (1852) 263. — Type: *Anon.* (K lecto), Bot. Gard. Calcutta.

Bauhinia piperifolia auct. non Roxb.: Prain, J. As. Soc. Beng. 66, ii (1897) 500.

This widespread species, distributed from India through Indochina to *Malesia* is in the Malesian area only represented by one of its 3 varieties.

var. *maritima* K. & S.S. Larsen

Bauhinia glabrifolia (Benth.) Baker var. *maritima* K. & S.S. Larsen, Thai For. Bull., Bot. 13 (1980) 40. — Type: *Helper* 1880 (K), 'Tenasserim & Andamans'.

Bauhinia glabrifolia auct. non (Benth.) Baker: Prain, J. As. Soc. Beng. 66, ii (1897) 500.

Bauhinia piperifolia auct. non Roxb.: Kurz, J. As. Soc. Beng. 45, ii (1876) 232; Fl. Burma 1 (1877) 400.

Phanera glabrifolia auct. non Benth.: de Wit, Reinwardtia 3 (1956) 486.

Slender, tendrilled *climber*, young branches reddish brown, later glabrous. *Leaves*: stipules lanceolate, falcate, c. 5 mm, with reddish hairs outside; petiole up to 9 cm, glabrescent; lamina ovate, up to 18.5 by 15 cm, bifid, 9-nerved. *Inflorescences* lateral, dense, compound corymbs with short, light brown, tomentose axis; pedicel up to 17 mm long; bracts triangular, 4–5 mm long, \pm persistent; bracteoles setaceous, 3–4 mm, \pm persistent, inserted about the middle of the pedicel. *Buds* globose with pointed apex, light brown, 2–3 mm diam. *Hypanthium* turbinate, c. 3 mm long, striate. *Calyx* splitting into 2 or 3, \pm reflexed segments. *Petals* yellowish white, subequal, obovate to spatulate, 6–8 mm long including the short claw; outside hairy at base and on the upper central part, glabrous towards apex. *Stamens* 3 fertile; filaments white, 10–12 mm long; anthers c. 2 mm; staminodes absent. *Ovary* c. 4 mm with a short stipe; style 4–5 mm; stigma small, capitate; sutures of ovary and stipe densely hairy. *Pods* broadly oblong, up to 17 by 6–7 cm, with a short beak. *Seeds* 3–5, flat, oblong, 21 by 12 mm, dark brown.

Distribution (of var. *maritima*) — Burma (Tenasserim), west coast of Peninsular Thailand; *Malesia*: Peninsular Malaysia (Penang, Perak).

Habitat — Found on limestone outcrops along the coast and also up to 250 m altitude.

26. *Bauhinia glabristipes* (de Wit) Cusset

Bauhinia glabristipes (de Wit) Cusset, Adansonia, n.s. 6 (1966) 278; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 20. — *Phanera glabristipes* de Wit, Reinwardtia 3 (1956) 442. — Type: *Teijsmann HB 10978* (U holo, n.v.), Kalimantan.

Large tendrilled *climber*; young branches rusty tomentose. *Leaves*: stipules early caducous (not seen); petiole 4–6(–12) cm long, first \pm densely reddish tomentose, later almost glabrous; lamina ovate-rotundate, 13–22 cm diam., 11–15-nerved, bifid 1/2–2/3; tip of lobes deltoid acute; base strongly cordate; upper surface glabrous, lower densely reddish tomentose when young, later almost glabrous except for the nerves. *Inflorescences* terminal, stout, many-flowered (but relatively narrow) racemes, 20–30 cm long, dark reddish brown tomentose; bracts ovate, acute, tomentose, 2–3 mm long; bracteoles similar, inserted near the middle of the pedicel; pedicel short, stout, 7–10 mm long, tomentose. *Buds* including the hypanthium fusiform, 4.5–5 cm long, c. 1 cm broad. *Hypanthium* densely tomentose, furrowed, 15–18 mm long, 5–6 mm broad. *Calyx* splitting into 5 reflexed, narrow sepals, c. 2.5 cm long, tomentose outside. *Petals* (colour?) oblong, short-clawed, silky tomentose outside. *Stamens* 3 fertile; filaments thick, anthers linear (only seen in bud); reduced stamens 2, hirsute (in bud 7 mm long); staminodes 2, minute, subulate. *Ovary* c. 1 cm, dark reddish tomentose, on a slender, glabrous stipe, c. 5 mm long; style 2.5–4 cm long, pubescent; stigma small, capitate. *Pods* oblong, up to 30 cm long, 5–6 cm broad. *Seeds* c. 6 (not seen).

Distribution — *Malesia*: Borneo (Sarawak). Only three specimens seen.

Habitat — Primary lowland forest.

27. *Bauhinia glauca* (Benth.) Benth.

Bauhinia glauca (Benth.) Benth., Fl. Hongk. (1861) 99; Baker in Hook. f., Fl. Brit. India 2 (1878) 282; Prain, J. As. Soc. Beng. 66, ii (1897) 186; Gagnep. in Fl. Indo-Chine 2 (1913) 138; Ridley, Fl. Malay Penins. 1 (1922) 629; Craib, Fl. Siam. Enum. 1 (1928) 521; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 10; in Fl. Camb., Laos & Vietnam 18 (1980) 183; in Fl. Thailand 4 (1984) 41; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 20. — *Phanera glauca* Wall. ex Benth. in Miq., Pl. Jungh. (1852) 265; Miq., Fl. Ind. Bat. 1, 1 (1855) 68; de Wit, Reinwardtia 3 (1956) 489; Backer & Bakh. f., Fl. Java 1 (1964) 534. — Types: *Wallich* 5785, *Amherst* 1827 (K lecto).

Bauhinia micrantha Ridley, J. As. Soc. Str. Br. 59 (1911) 98; Fl. Malay Penins. 1 (1922) 633. — Type: *Ridley* 15108 (SING holo).

Subsp. **glauca** is the only infraspecific taxon, represented in *Malesia*.

Tendrilled *liana*; young branches reddish pubescent, soon glabrous. *Leaves*: stipules linear, c. 4 mm long; petiole sparsely pubescent, 2–4 cm; lamina broadly ovate to rotundate, often broader than long, 4–6(–9) cm diam.; 7–11-nerved; bifid 1/3–1/2 with narrow sinus; tip of lobes obtuse; base truncate to cordate; upper surface glabrous, lower sparsely pubescent. *Inflorescences* lateral, short, dense corymbs; pedicel slender, 1–2 cm, ± rusty pubescent; bracts linear, 5 mm long; bracteoles similar, inserted near the middle of the pedicel. *Buds* ovoid, 4–5 mm, glabrous to sparsely hairy. *Hypanthium* tubular, ± glabrous, striate, 10–15 mm long. *Calyx* splitting into 2–3 reflexed segments, 4 mm long. *Petals* white, subequal, obovate, 8–12 mm long including the 2–3 mm long claw, ± hairy outside. *Stamens* 3 fertile; filaments glabrous, as long as petals; anthers dark red, ellipsoid, 2 mm long; staminodes 7: 2 between the stamens, 3 mm long, 5 short, subulate, connate at base. *Ovary* glabrous, 8 mm long, shortly stipitate; style very short; stigma obliquely peltate. *Pods* flat, oblong, thin-valved, indehiscent, 18–25 by 3–5.5 cm. *Seeds* 10–25, ovate, 5–8 mm long.

Distribution — From India, through Burma, to S China, Laos, Cambodia and Vietnam; *Malesia*: Malay Peninsula and Indonesia. In the northern part of the area it is represented by subsp. *tenuiflora* (Watt ex C.B. Clarke) K. & S.S. Larsen, in the southern part, i.e. S India, Burma, Malay Peninsula, Sumatra and Java, by subsp. *glauca*.

Habitat — Along margins of evergreen forests, in clearings, up to 500 m altitude.

28. *Bauhinia gracillima* (de Wit) Cusset

Bauhinia gracillima (de Wit) Cusset, Adansonia, n.s., 6 (1966) 279. — *Phanera gracillima* de Wit, Reinwardtia 3 (1966) 474. — Type: *Castro* 4425 (SING holo; K, L), Sabah.

Slender *climber*; young branches finely pubescent, later glabrous. *Leaves*: stipules narrow triangular, acute, early caducous; petioles (1.5–)3–8 cm, very slender; lamina suborbicular, often broader than long, 5–10 cm diam., 11–13-nerved; nerves very prominent below; bifid 1/3–1/2 with rather narrow sinus; tip of lobes broadly rounded, base truncate to shallowly cordate; upper surface glabrous or nearly so, lower minutely appressed pubescent. *Inflorescences* few-flowered, terminal corymbs; pedicels very slender, 3.5–5 cm, subglabrous; bracts linear, 3–5 mm, glabrous; bracteoles filiform, 3–4

mm, inserted below the middle of the pedicel. *Buds* narrowly fusiform, sparsely pubescent, 10–12 by 2–3 mm. *Hypanthium* turbinate, c. 2 mm. *Calyx* splitting into 2 or 3 finally reflexed lobes. *Petals* greenish(?), 1.5–2.5 cm long including the very narrow to almost filiform, 5–15 mm long claw; the blade narrowly lanceolate with finely undulate margin, inside pubescent towards the claw, outside glabrous. *Stamens* 2 fertile, filaments glabrous, 10–13 mm, slender; anthers c. 2 mm long; staminodes c. 7, small, 1–2 mm, with broadened base, some with minute anthers. *Ovary* 4–5 mm on a c. 3 mm long, slender stipe, puberulous; style slender, 5–7 mm, glabrous; stigma inconspicuous. *Pods* unknown.

Distribution — *Malesia*: endemic to Borneo (NE Sandakan, only few collections are known from the Kaloili-Sepilok Forest Reserve).

Note — De Wit (l.c.) quoted the flowers as olive green from the label of the holotype; on the label of a new collection from the same area the collector notes 'flowers white'.

29. *Bauhinia hendersonii* (de Wit) Cusset

Bauhinia hendersonii (de Wit) Cusset, *Adansonia*, n.s., 6 (1966) 279. — *Phanera hendersonii* de Wit, *Reinwardtia* 3 (1956) 456. — Type: *Henderson SF 20515* (SING holo), not *10515* as cited by De Wit.

Large tendrilled climber; young branches grooved, greyish brown, short tomentose. *Leaves*: stipules ovate-acute, tomentose, c. 3 mm, early caducous; intrastipular trichomes numerous, delicate; petiole stout, 4–6 cm, reddish brown pubescent; lamina ovate-orbicular, 11–15 cm diam., 13-nerved, bifid 2/5 with rather broad sinus; lobes broadly deltoid, \pm acute, base deeply cordate; upper surface greyish brown tomentose in young leaves, later subglabrous except for the nerves; lower reddish brown pubescent particularly on the nerves. *Inflorescences* short, subcorymbose, 5–15 cm long, with light brownish pubescent axis; pedicels light brown tomentose, angulate, c. 2.5 cm; bracts ovate-oblong, acute, c. 6 mm long, tomentose outside, thinly pubescent inside; bracteoles similar, somewhat narrower and shorter, inserted above the middle of the pedicel. *Buds* light brown tomentose, broadly ellipsoid, 10–14 mm. *Hypanthium* tubular, striate, c. 13 mm long. *Calyx* splitting into 2–4(–5) segments, inside glabrous. *Petals* white, densely brown pubescent outside, glabrous inside, obovate with crenulate margins, 25 by 12–15 mm, with a short claw. *Stamens* 3 fertile, filaments glabrous, 3–3.5 cm; anthers 6–8 mm, broadly elliptic; staminodes 4 or 5, subulate, 2–6 mm long. *Ovary* recurved, golden tomentose, c. 7 mm, on a 3 mm long, glabrous stipe; style tomentose, as long as ovary; stigma small, capitate. *Pods* dehiscent, strap-shaped, 26 by 5 cm, reddish brown tomentose. *Seeds* (young) c. 10, flat, orbicular, c. 12 mm diam.

Distribution — *Malesia*: endemic to the Anambas Islands.

Note — This species is only known from the type collection which was annotated by M.R. Henderson: 'Common here, usually in secondary growth and open places, but rarely in forest', alt. 30 m. De Wit (l.c.) regards it as closely related to the Indian species *B. vahlii* Wight & Arn., but this is hardly the case.

30. *Bauhinia integrifolia* Roxb.

- Bauhinia integrifolia* Roxb. [Hort. Beng. (1814) 90, nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 331; Baker in Hook. f., Fl. Brit. India 2 (1878) 279; Craib, Fl. Siam. Enum. 1 (1928) 522; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 11; Fl. Thailand 4 (1984) 38, f. 9/1–3; Nord. J. Bot. 13 (1993) 658; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19. — *Phanera integrifolia* (Roxb.) Benth. in Miq., Pl. Jungh. (1852) 263; Miq., Fl. Ind. Bat. 1, 1 (1855) 64; *ibid.*, Suppl. (1861) 286; de Wit, Reinwardtia 3 (1956) 478. — Type: *Wallich 5780* (K lecto; C, E, G, P), Penang I.
- Phanera cumingiana* Benth. in Miq., Pl. Jungh. (1852) 263; Miq., Fl. Ind. Bat. 1, 1 (1855) 68. — *Bauhinia cumingiana* (Benth.) Fern.-Vill., Nov. App. (1880) 73; Vidal, Phan. Cuming. Philipp. (1885) 110; Rev. Pl. Vasc. Filip. (1886) 116; Perkins, Fragm. Fl. Philipp. 1 (1904) 9; Merr., Philipp. J. Sc., Bot. 5 (1910) 44; Sp. Blanc. (1918) 171. — Type: *Cuming 1785* (not 1789) (K lecto; E, G, L, OXF, P, PRC, W), Philippines.
- Phanera junghuhniana* Benth. in Miq., Pl. Jungh. (1852) 265. — Type: *Junghuhn 240/245* (K lecto). See Nord. J. Bot. 13 (1993) 658.
- Phanera polyantha* Miq., Fl. Ind. Bat. 1, 1 (1858) 1079; 'polyanthra' Ind. Kew. sphalm. — Type: *Teijsmann HB 897* (U), Sumatra.
- Phanera bicornuta* Miq., Fl. Ind. Bat., Suppl. (1861) 286. — *Phanera bidentata* subsp. *bicornuta* (Miq.) de Wit, Reinwardtia 3 (1956) 499. — Type: *Teijsmann HB 878* (U).
- Bauhinia brachyscypha* Baker, Kew Bull. (1896) 22. — Type: *Creag s.n.* 1895 (K holo), Sabah.
- Bauhinia macropoda* Baker, Kew Bull. (1896) 22. — Type: *Creag s.n.* 1895 (K holo), Sabah.
- Bauhinia nymphaeifolia* Perkins, Fragm. Fl. Philipp. 1 (1904) 11; Merr., Philipp. J. Sc., Bot. 5 (1910) 45; Enum. Philipp. Flow. Pl. 2 (1923) 260. — Type: *Cuming 1181* (K lecto; E, G, L, P, PRC, W), Luzon.
- Bauhinia whitfordii* Elmer, Leaflet Philipp. Bot. 1 (1907) 229. — Type: *Elmer 8897* (NY lecto; E, K, W).
- Bauhinia holosericea* Ridley, J. As. Soc. Str. Br. 75 (1917) 182. — Type: *Ridley 14674* (K holo), Perak.
- Bauhinia flammifera* Ridley, J. As. Soc. Str. Br. 82 (1920) 182; Fl. Malay Penins. 1 (1922) 631; Craib, Fl. Siam. Enum. 1 (1928) 521; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 311; Merr., Pap. Mich. Acad. Sc. 24 (1929) 73. — Type: *Griffith s.n.* (K holo; BR), Malacca.
- Bauhinia scandens* auct. non L.: Blanco, Fl. Filip. (1837) 332; ed. 2 (1845) 232; ed. 3, 2 (1878) 78.
- Phanera vahlii* auct. non Benth.: Naves in Blanco, Fl. Filip., ed. 3, 2 (1878) pl. 76.
- Bauhinia vahlii* auct. non Wight & Arn.: Fern.-Vill., Nov. App. (1880) 72.

KEY TO SUBSPECIES AND VARIETIES

- 1a. Buds globose to ovoid; filaments longer than petals; style glabrous in upper half **a. subsp. *integrifolia***
- b. Buds ovoid to ellipsoid; filaments shorter than petals; style hairy **b. subsp. *cumingiana*** 2
- 2a. Lower leaf surface glabrescent **b1. var. *cumingiana***
- b. Lower leaf surface persistently fuscous brown woolly **b2. var. *nymphaeifolia***

a. subsp. *integrifolia*

Phanera junghuhniana Benth. — *Phanera bicornuta* Miq. — *Phanera polyantha* Miq. — *Bauhinia holosericea* Ridley — *Bauhinia flammifera* Ridley.

Large tendrilled *climber*; young branches rusty woolly and grooved. *Leaves*: stipules minute, rounded, early caducous; petioles rusty puberulous, 1–5 cm; lamina broadly

ovate to orbicular, up to 15 cm; 9–11-nerved; entire to emarginate or shallowly bifid with a wide, deltoid sinus; tip of lobes acute to obtuse; base deeply cordate; upper surface glabrous, glossy, lower first puberulous, later glabrous except sometimes on the nerves. *Inflorescences* multiflowered, \pm dense panicles composed of corymbose racemes, axis rusty pubescent; pedicels slender, up to 3 cm; bracts narrowly lanceolate, up to 3 mm; bracteoles minute, (usually) inserted about the middle of the pedicel. *Buds* globose to ovoid with acute apex, 3–4 mm diam. *Hypanthium* tubular, striate, puberulous, 2–4 mm. *Calyx* splitting into 2 (or 3) reflexed lobes. *Petals* unequal, orange turning red, obovate, tapering towards the short claw, 8–15 mm, margin crenulate, outside densely rusty-hirsute. *Stamens* 3 fertile, filaments filiform, hairy at base, slightly longer than petals; anthers ellipsoid, c. 1 mm; staminodes 2, minute. *Ovary* subsessile, rusty woolly; style in upper 2/3 glabrous; stigma capitate. *Pods* dehiscent, oblong, puberulous when young, later glabrous, 15–20 by 25 cm. *Seeds* 5–8, flat, ovate-orbicular, c. 2 cm diam.

Distribution — *Malesia*: Sumatra, Malay Peninsula from the Isthmus of Kra (Thailand) southwards.

Habitat — Common from the lowland up to 1200 m altitude.

Uses — Bast fibres; sap locally as medicine.

Note — The type of *Phanera bicornuta* Miq. (U) consists of two sterile branches, some loose leaves, a loose pod and one seed. This specimen was treated by De Wit under *Phanera bidentata* as subsp. *bicornuta*. Nothing in the material, however, suggests that this specimen belongs there; most certainly it belongs to *Bauhinia integrifolia*, even Miquel writes in the protologue that it is close to *Phanera polyantha* (= *Bauhinia integrifolia*).

b. subsp. *cumingiana* (Benth.) K. & S.S. Larsen

Bauhinia integrifolia Roxb. subsp. *cumingiana* (Benth.) K. & S.S. Larsen, Nord. J. Bot. 2 (1982) 332; ibid. 13 (1993) 658. — *Phanera cumingiana* Benth. in Miq., Pl. Jungh. (1852) 263. — *Phanera integrifolia* (Roxb.) Benth. subsp. *cumingiana* (Benth.) de Wit, Reinwardtia 3 (1956) 480.

Bauhinia brachyscypha Baker — *Bauhinia macropoda* Baker.

Bauhinia scandens auct. — *Phanera vahlII* auct. — *Bauhinia vahlII* auct.

Deviates from subsp. *integrifolia* in leaves always deeply bifid; lobes obtuse to acuminate. Pedicels longer, buds larger and ovoid to ellipsoid, 5–10 mm long. Stamens: filaments shorter than petals; anthers c. 3 mm long. Ovary appressed pubescent; style pubescent to sparsely hairy towards the stigma.

Distribution — *Malesia*: Borneo (Sabah), Philippines.

Habitat — Common in lowland forests.

b1. var. *cumingiana*

Leaves with glabrescent undersides.

Distribution — *Malesia*: Borneo (Sabah), Philippines.

b2. var. *nymphaeifolia* (Perkins) K. & S.S. Larsen

Bauhinia integrifolia Roxb. subsp. *cumingiana* (Benth.) K. & S.S. Larsen var. *nymphaeifolia* (Perkins) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 658. — *Bauhinia nymphaeifolia* Perkins, Fragm. Fl. Philipp. 1 (1904) 11. — *Phanera integrifolia* (Roxb.) Benth. subsp. *cumingiana* (Benth.) de Wit var. *nymphaeifolia* (Perkins) de Wit, Reinwardtia 3 (1956) 482.

Bauhinia whitfordii Elmer.

Leaves persistently fuscous woolly on the lower surface.

Distribution — *Malesia*: Philippines (Luzon).

Note — There are only four collections, all from Luzon. Of all the characters mentioned by earlier authors only the leaf-hairiness really separates it from var. *cumingiana*.

31. *Bauhinia kostermansii* K. & S.S. Larsen

Bauhinia kostermansii K. & S.S. Larsen, Nord. J. Bot. 11 (1991) 629. — Type: *Kostermans 13549* (L holotype; BO, K, P), Kalimantan.

Tendrilled *liana*, the young branches terete, ferrugineous pubescent, later glabrous. *Leaves*: stipules obovate with truncate, dentate apex, 8–10 by 3–6 mm, sparsely hairy on both sides, tardily caducous; petiole c. 5 mm, pubescent; lamina coriaceous, ovate, 3.5–5.1 by 3.5–3.8 cm; 11–13-nerved, nerves prominent on the lower side; bifid 1/3 or less (deeper on sterile shoots); tip of lobes obtuse, base truncate to shallowly cordate; upper surface glabrous, lower pubescent. *Inflorescences* few-flowered, terminal and lateral racemes, sometimes joined in larger panicles; axis very short, 1–2 cm, ferrugineous-tomentose as all external parts of the inflorescence; pedicels 2–6 mm; bracts lanceo-

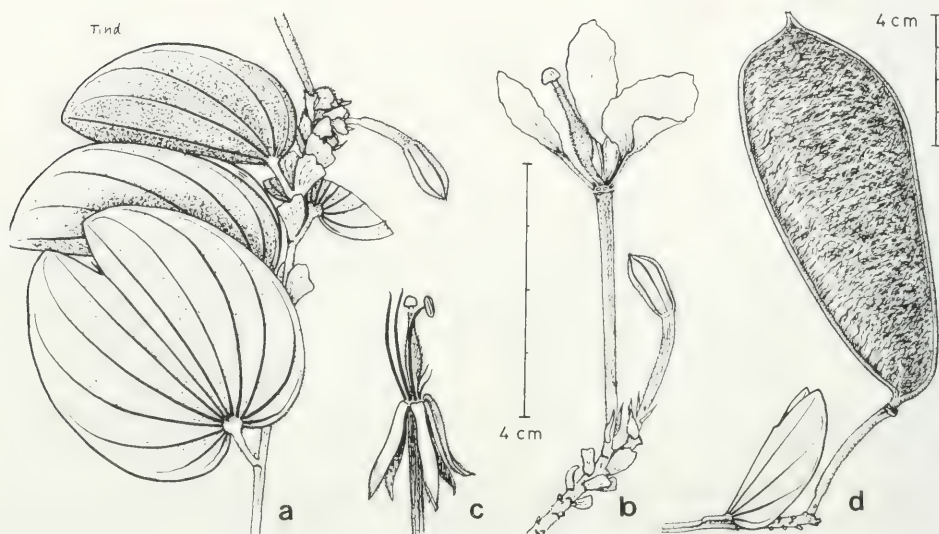


Fig. 9. *Bauhinia kostermansii* K. & S.S. Larsen. a. Leafy twig; b. part of the inflorescence. c. flower; d. fruit (*Kostermans 13549*). Drawing K. Tind.

late, acuminate, c. 5 mm, silky hairy; bracteoles smaller, narrowly lanceolate, subulate, inserted about the middle of the pedicel. *Hypanthium* 3.5–4 cm long, gradually tapering into the pedicel. *Buds* clavate, apiculate with truncate base, calyx splitting into 5 strap-shaped, early caducous sepals. *Petals* white turning green, outside densely silky hairy, inside glabrous, unequal; lamina lanceolate, 15–20 mm long, 9–15 mm broad, upper one broader and slightly shorter, distinctly clawed, claw 4–7 mm. *Stamens* 3 fertile, early caducous; filaments 12–18 mm; anthers 2–3 mm; staminodes 2, c. 5 mm. *Ovary* ferruginous tomentose, shortly stipitate, c. 15 mm including the style; style tomentose, short, glabrous just below the capitate stigma. *Pods* glabrous, rugulose, obovate-oblong, 11.5–12.5 by 4.5–5 cm, with a strong beak. *Seeds* 2 or 3 (ripe seeds not seen). — **Fig. 9.**

Distribution — *Malesia*: Borneo (Sabah and E Kalimantan along the Berau River).

Note — This species is related to *Bauhinia lingua* which, however, does not occur in Borneo. The pedicels of the present species are much shorter and the hypanthium is longer. The small leaves are very distinctive. Kostermans writes that the white flowers turn green; this is unusual; in other white-flowered species of this group they become cream-coloured with age.

32. *Bauhinia lingua* DC.

Bauhinia lingua DC., Prodr. 2 (1825) 516; [*Folium linguae* Rumph., Herb. Amb. 5 (1747) 1, pl. 1]; Merr., Interpr. Rumph. (1917) 256; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 736. — *Phanera lingua* (DC.) Miq., Fl. Ind. Bat. 1, 1 (1855) 67; de Wit, Reinwardtia 3 (1956) 458. — Type: Plate in Rumph., Herb. Amb.

Bauhinia teijsmanniana Scheff., Ann. Jard. Bot. Buitenzorg 1 (1876) 19; Koord., Minahasa (1898) 427 ('*teijsmanianum*'), 629, in syn.; Kaneh. & Hatus., Bot. Mag. Tokyo 56 (1942) 362. — *Phanera teijsmanniana* (Scheff.) Warb., Bot. Jahrb. 13 (1891) 332. — Type: *Teijsmann 7801* (L lecto; C, MEL), New Guinea.

Bauhinia riedelii Baker, J. Linn. Soc. London, Bot. 15 (1877) 98. — *Phanera riedelii* (Baker) de Wit, Reinwardtia 3 (1956) 463. — Type: *Riedel s.n.* (K lecto; P, W), Celebes.

Bauhinia minahassae Koord., Minahasa (1898) 629. — Type: *Koorders 17464* (BO holo; L), Celebes.

Bauhinia warburgii Perkins, Fragm. Fl. Philipp. 1 (1904) 12; Merr., Philipp. J. Sc., Bot. 5 (1910) 46; Enum. Philipp. Flow. Pl. 2 (1923) 261. — Type: *Warburg 12823* (n.v.), Luzon.

Bauhinia pinchotiana Perkins, Fragm. Fl. Philipp. 1 (1904) 12; Merr., Philipp. J. Sc., Bot. 5 (1910) 45. — Type: *Cuming 1119* (K lecto; E, G, L, P, W), Luzon.

Bauhinia antipolana Perkins, Fragm. Fl. Philipp. 1 (1904) 9; Merr., Philipp. J. Sc., Bot. 5 (1910) 45. — Type: *Merrill 1317* (NY), Luzon.

Bauhinia chalcobapta Quisumb. & Merr., Philipp. J. Sc. 37 (1928) 151. — Type: *Ramos & Edaño 47217* (NY), Luzon.

Bauhinia scandens auct. non L.: L., Sp. Pl., ed. 2, 2 (1762) 535.

Bauhinia semibifida auct. non Roxb.: Vidal, Atlas (1883) 24, p. 43, f. 1; Fern.-Vill., Nov. App. (1880) 73.

Note — *Bauhinia lingua* is a very polymorphous species like *B. semibifida* and some of its variations approach *B. aherniana*. We have separated two varieties based on formerly proposed species but a number of other species described are less easy to maintain. It is evident that isolated populations to some extent have become recognizable. Thus

small-flowered specimens from N Luzon have been dealt with as *B. pinchotiana*, similar appearance is found among collections from the Moluccas. Large-flowered plants from various localities in the central Philippines have been treated as *B. warburgii*; other large-flowered plants from Celebes have been described as *B. minahassae*. A collection from Butuan City, Philippines (PNH 98205) with almost glabrous leaves and flower buds may represent an undescribed taxon; the material, however, has no fully developed flowers.

It is possible that, when a much larger amount of material is available and extensive field studies undertaken, some of these variations could be recognized formally; but at the present moment we find it safer to avoid further splitting.

Still *Bauhinia lingua* is most easily distinguished on its narrow tubular hypanthium, gradually tapering towards the pedicel.

KEY TO THE VARIETIES

- 1a. Style glabrous towards the stigma 2
- b. Style hairy throughout to the stigma **b. var. antipolana**
- 2a. Inflorescence glabrescent to \pm velvety **a. var. lingua**
- b. Inflorescence densely woolly **c. var. riedelii**

a. var. lingua

Bauhinia teijsmanniana Scheff. — *Bauhinia minahassae* Koord. — *Bauhinia warburgii* Perkins — *Bauhinia pinchotiana* Perkins.

Tendrilled *liana*; young branches velvety rusty tomentose. *Leaves*: stipules obovate with truncate apex, hairy along the margin, 4–10 mm, early caducous; petiole 3–6 cm, brownish pubescent; lamina broadly ovate to suborbicular, 8–10(–17) cm across; 11–13-nerved; bifid 1/3–1/2; tip of lobes obtuse or acute (to acuminate), base cordate; upper surface glabrous, lower brownish pubescent to subglabrous. *Inflorescences* lateral and terminal, glabrescent to \pm brown velvety corymbs; pedicels 2–4 cm long; bracts narrow lanceolate, acuminate, 3–5 mm, pubescent, early caducous; bracteoles smaller, subulate, inserted near the base of the pedicel. *Buds* clavate-ellipsoid, \pm apiculate, 1–2 cm. *Hypanthium* narrowly tubular, 10–25(–35) mm, gradually tapering towards the pedicel, brownish velvety pubescent as the bud. *Calyx* splitting into 5 free, reflexed sepals, 12–15 mm long. *Petals* white turning yellow, unequal, 25–35 mm long, narrowly obovate-lanceolate with broad rounded apex, tapering into the 4–6 mm long claw, outside mostly appressed brownish silky hairy towards the base and along the median line, sometimes only sparsely hairy. *Stamens* 3 fertile; filaments glabrous, 22–25 mm; anthers 5–8 mm; staminodes 2, subulate, 6–10 mm, sometimes also 1–2 minute ones, c. 1 mm, between the fertile ones. *Ovary* rusty hairy, on a short, glabrous stipe; style usually glabrous; stigma peltate, 2–3 mm diam. *Pods* narrowly oblong, 12–22 by 3.5–5 cm, glabrous. *Seeds* 4–8, flat, 1.5–2.5 cm diam.

Distribution — *Malesia*: Philippines, Celebes, Lesser Sunda Islands, New Guinea.

Habitat — From sea level up to c. 1000 m altitude; often collected in dry forests, on limestone and volcanic tuff, but also found in lowland humid forests.

Uses — For ropes. Locally the young leaves are eaten as vegetable and according to Rumphius the leaves are extracted with the juice of *Arenga* for the taste.

b. var. antipolana (Perkins) K. & S.S. Larsen

Bauhinia lingua DC. var. *antipolana* (Perkins) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 660. — *Bauhinia antipolana* Perkins.

Bauhinia chalcobapta Quisumb. & Merr.

Leaves ovate to ovate oblong, divided c. 1/2 with a narrow sinus. Inflorescences longer and with more numerous flowers. Petals more hairy outside; style hairy throughout.

Distribution — *Malesia*: Philippines (N and C Luzon).

Habitat — In open forests, altitude c. 650 m.

c. var. riedelii (Baker) K. & S.S. Larsen

Bauhinia lingua DC. var. *riedelii* (Baker) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 660. — *Bauhinia riedelii* Baker — *Phanera riedelii* (Baker) de Wit.

All young parts and inflorescences woolly. Inflorescences c. 5 cm long (rarely longer). Hypanthium c. 2 cm long. Petals densely hairy outside. Stamens 15–20 mm; staminodes 2 or 3. Style pubescent, glabrous towards the capitate stigma. Pods unknown. The few open flowers in the type specimen have petals finally with recurved margin, as also mentioned by de Wit.

Distribution — *Malesia*: Celebes and Halmahera.

Habitat — Various habitats at low altitudes.

33. Bauhinia merrilliana Perkins

Bauhinia merrilliana Perkins, Fragm. Fl. Philipp. 1 (1904) 10. — *Phanera merrilliana* (Perkins) de Wit, Reinwardtia 3 (1956) 461. — Type: *Elmer 694* (A holo; BM, SING), Palawan.

KEY TO THE VARIETIES

- a. Inflorescences a dense ± elongate raceme; pedicels 0.8–2 cm . . . **a. var. merrilliana**
b. Inflorescences corymbose; pedicels 3–5 cm **b. var. borneensis**

a. var. merrilliana

Slender, tendrilled climber; young branches ferruginous pubescent, later glabrous. Leaves: stipules broadly obovate, pubescent on both sides, 3–6 mm long; petioles 1–2

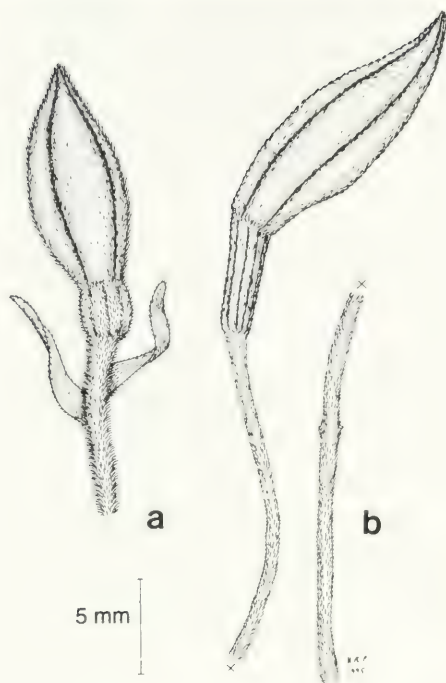


Fig. 10. *Bauhinia merrilliana* Perkins var. *merrilliana*. a. Flower bud (Merrill 694). — *Bauhinia merrilliana* Perkins var. *borneensis* K. & S.S. Larsen. b. Flower bud (Paie S 28594). Drawing H.Æ. Pedersen.

cm long, slender, ferrugineous pubescent; lamina broadly ovate-oblong to orbicular, 2.5–5 by 3–5 cm; 7–9-nerved; bifid 1/2–2/3 with rather wide sinus; tip of lobes subacute to obtuse, base cordate; upper surface finely pubescent, later glabrous, lower rusty pubescent, later mainly on the nerves. *Inflorescences* terminal on leafy shoots, many-flowered, dense, \pm elongate racemes; pedicels (8–)10–20 mm, densely pubescent; bracts ovate-lanceolate, 7–10 mm long, pubescent on both sides; bracteoles linear, 4–6 mm long, inserted about the middle of the pedicel or lower. *Buds* ellipsoid to apiculate, ferrugineous-pubescent, about 1 cm long. *Hypanthium* tubular, striate, 4–6 mm long. *Calyx* splitting into 5 (or rarely 4) strap-shaped lobes. *Petals* white, turning yellowish to orange, subequal; blade lanceolate, 7–10 mm long, hairy outside except along the margin, subglabrous inside, claw distinct, c. 3 mm, sparsely hairy on both sides. *Stamens* 3 fertile; filaments glabrous, 10–13 mm; anthers 3–5 mm; staminodes 2, glabrous, subulate, with enlarged flattened apex, 3–5

mm, sometimes with 1 or 2 minute ones, filiform c. 1 mm. *Ovary* densely rusty pubescent, c. 5 mm, the stipe short, 2–3 mm, entirely pubescent as the 4–5 mm long style; stigma peltate, 1–2 mm. *Pods* glabrous, woody, 11–15 by 3 cm, tapering towards both ends. *Seeds* 5–7, compressed, orbicular, dark brown, 9–15 mm across. —

Fig. 10a.

Distribution — *Malesia*: Philippines (Palawan only).

Habitat — In lowland forests.

b. var. *borneensis* K. & S.S. Larsen

Bauhinia merrilliana Perkins var. *borneensis* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 658. — Type: Ilias Paie SAN 28594 (L holo; E, K, SAR, SING), Sarawak.

Deviates from var. *merrilliana* by the somewhat larger leaves, 9–11-nerved, divided 1/3–1/2 and by the broad, corymbose inflorescence with the pedicels 3–5 cm long; floral parts also slightly larger. — **Fig. 10b.**

Distribution — *Malesia*: Borneo (Sarawak and Sabah).

Habitat — In mountain forests up to 1500 m on Mt Kinabalu.

34. *Bauhinia pachyphylla* Merr.

Bauhinia pachyphylla Merr., Philipp. J. Sc. 27 (1925) 24; Enum. Philipp. Flow. Pl. 4 (1926) 252. — *Phanera pachyphylla* (Merr.) de Wit, Reinwardtia 3 (1956) 461. — Type: *Loher 12978* (K lecto; M), Luzon.

KEY TO THE VARIETIES

- a. Adult leaves glabrous; nerves prominent below; inflorescence axis zig-zag; hypanthium infundibuliform, 15–18 mm long, 6 mm diam. **a. var. *pachyphylla***
- b. Adult leaves sparsely tomentose below; inflorescence axis straight; hypanthium tubular, at least 20 mm long, 2–3 mm diam. **b. var. *wenzelii***

a. var. *pachyphylla*

Tendrilled *liana*, glabrous except for the inflorescence. *Leaves*: stipules early caducous (not seen); petiole stout, 10–15 mm; lamina broadly ovate to suborbicular, thickly coriaceous, c. 10 cm across; bifid 1/3–2/5; tip of lobes obtuse, base deeply cordate; 11-nerved; upper surface glabrous, lower first sparsely pubescent, soon glabrous, with very prominent nerves and a distinct, fine reticulation. *Inflorescences* terminal, 20–30 cm long, narrow racemes, axis dark brown velvety, distinctly zig-zag with elevated pedicel-bases; pedicels thick, c. 15 mm, densely brown pubescent; bracts woolly, ovate acute, 6–7 mm; bracteoles similar, but much narrower, inserted at the base of the pedicel. *Buds* ovoid-globose, 9–12, thick brown velvety pubescent. *Hypanthium* infundibuliform, 15–18 by 6 mm. *Calyx* splitting into 5 strap-shaped sepals, apparently not reflexed. *Petals* pale yellow, outside pubescent, inside glabrous, c. 2.5 cm long including the c. 10 mm long claw; blade elliptic, obtuse, tapering towards the base. *Stamens* 3 fertile; filaments glabrous, c. 15 mm long; anthers oblong, c. 7 mm. *Ovary* shortly stipitate, densely coppery tomentose; style stout, tomentose; stigma small, peltate. *Pods* narrowly oblong, thin-valved, c. 13 by 3.5–4 cm, when young ferruginous pubescent, later glabrous and glossy. *Seeds* c. 6, flat, c. 15 mm across. (Fruiting characters are quoted from Merrill, l.c.; the material in K is a flowering specimen.)

Distribution — *Malesia*: Philippines (Luzon, only known from the type locality in the Rizal Province).

Notes — 1. Both Merrill and De Wit regard this as a very distinct taxon and we fully agree even if only the type collection is known. We have studied the specimen in K and the characteristic leaves, the inflorescence axis and bud shape together with the broad, stout hypanthium are all very remarkable. One specimen from Balar, Quezon (Luzon) in floral characters agrees with this species; the leaves, however, on a sterile shoot are divided 2/3 and with acute lobes. The type locality now lies within the limits of Metropolitan Manila and is probably deprived of its original vegetation.

2. *Quisumbing PNH 2458*, also from Quezon, studied from SING, is a fruiting branch. The inflorescence axis and the hypanthium suggest this variety but the leaves are narrowly ovate, 5.5–7.5 by 4–5 cm, divided 2/3 with narrow sinus and narrow triangular lobes. This may represent a new variety.

b. var. *wenzelii* K. & S.S. Larsen

Bauhinia pachyphylla Merr. var. *wenzelii* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 659. — Type: Wenzel 2537 (NY holo; BO, BR, K, MO, PR), Mindanao.

Deviates from var. *pachyphylla* in the leaf texture being thinner and in the persistent tomentose indumentum. The inflorescence axis is straight but has the prominent knobs of the shed pedicel-bases; the pedicels are thinner and slightly longer. The buds are elliptic with acute apex. The hypanthium is much narrower, tubular and distinctly longer, 20 mm or more with a diameter of 2–3 mm.

Distribution — *Malesia*: Philippines (known from Mindanao, prov. Surigao).

Note — We have studied the collections Wenzel 2537 and Mendoza & Convozar PNH 10296, both have been identified as *Bauhinia perkinsae* with which species it has no resemblance.

35. *Bauhinia pauciflora* Merr.

Bauhinia pauciflora Merr., Philipp. J. Sc., Bot. 10 (1915) 13. — *Phanera pauciflora* (Merr.) de Wit, Reinwardtia 3 (1956) 462. — Type: Foxworthy & Ramos BS 13113 (K lecto), Luzon.

Slender, tendrilled climber; young parts rusty pubescent, later glabrous. *Leaves*: stipules triangular, 3–4 mm long, hirsute, early caducous; petioles slender, 3–6 cm, glabrous to sparsely pubescent; lamina ovate, up to 12 by 8 cm; 9-nerved; bifid 1/2–3/4 with a wide sinus; lobes narrow, triangular, acute, base cordate; upper surface glabrous, lower \pm appressed rusty pubescent to almost glabrous. *Inflorescences* terminal and lateral few-flowered racemes with rusty pubescent axis, up to 10 cm long; pedicels slender, 20–25 mm, rusty puberulous; bracts narrow triangular, outside thinly pubescent, c. 5 mm; bracteoles linear, acute, c. 3 mm, inserted about the middle of the pedicel. *Buds* obovoid to oblong, 10–20 mm, apiculate, brownish puberulous. *Hypanthium* tubular, striate, 1.5–2 mm long, sparsely short puberulous, gradually tapering towards the pedicel. *Calyx* splitting into 5 free, strap-shaped segments, 1–3 cm long, finally reflexed. *Petals* white turning yellowish, ovate-oblong, obtuse, 1.5–3 cm long, with a 3–5 mm long claw, sparsely hairy to almost glabrous outside. *Stamens* 3 fertile; filaments glabrous, 1.5–2.5 cm; anthers ellipsoid, c. 5 mm; staminodes 2.7–10 mm. *Ovary* appressedly brown silky pubescent, on a short stipe; style \pm glabrous; stigma peltate. *Pods* unknown.

Distribution — *Malesia*: Philippines (Luzon).

Habitat — Collected at 1400 m altitude.

Note — This species apparently is rare and still needs further study to be fully understood. Merrill writes that it is closely related to *Bauhinia warburgii*, i.e. *B. integrifolia* var. *cumingiana*; we do not think this is the case, because not only the leaves are different but also the flower structure differs. De Wit, l.c., in his description cites two specimens, one from Prov. Tayabas and one from Rizal. We have hesitatingly emended the description and added a flowering specimen (*Lagrimas* 608) from Prov. Zambas; this plant has smaller floral parts and a more corymbose inflorescence with c. 20 flowers. Further a sterile specimen from Mountain Province, Conklin & Buwaya I-937 (PNH 79526) probably belongs here.

36. *Bauhinia praesignis* Ridley

Bauhinia praesignis Ridley, Fl. Malay Penins. 5 (1925) 305; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 20. — *Phanera praesignis* (Ridley) de Wit, Reinwardtia 3 (1956) 444. — Type: Burkill 16404 (K holo), Malay Peninsula.

Large tendrilled climber, all parts reddish brown velvety; stems c. 2 cm diam., young branches striate. *Leaves*: stipules auriculate, glabrous inside, c. 15 mm broad; petiole stout, 4–8 cm long; lamina ovate, 18–25 by 15–20 cm, 13–15-nerved; bifid 1/3; tip of lobes acute to obtuse, base deeply cordate; upper surface glabrous; lower densely reddish brown, woolly pubescent. *Inflorescences* terminal, to 30 cm long, rusty velvety racemes, sometimes with 1 (or 2) basal side branches; axis angulate; bracts ovate, carinate, 15–25 mm long, velvety outside, glabrous inside; bracteoles lanceolate, slightly smaller, inserted at the base of the hypanthium. *Buds* incl. hypanthium fusiform, velvety, 3–4.5 by 1 cm. *Hypanthium* campanulate, 1.5–2 cm long. *Calyx* splitting into (4 or) 5 fleshy, strap-shaped sepals. *Petals* white, narrowly lanceolate, 3.5–4 cm long, tapering towards the claw, reddish brown hairy outside. *Stamens* 3 fertile, red; filaments stout, c. 25 mm (in bud); anthers 2–2.5 cm long, narrowly ellipsoid; staminodes 2, stout, 12–14 mm long with bifid apex. *Ovary* c. 1 cm, stipe reddish pubescent, c. 1 cm; style thick; stigma indistinct. *Pods* strap-shaped, red, velvety, c. 20 cm long (not seen). *Seeds* 6 or 7 (not seen).

Distribution — *Malesia*: southern part of the Malay Peninsula (Pahang, Negri Sembilan).

Habitat — No data available.

37. *Bauhinia rahmatii* Merr.

Bauhinia rahmatii Merr., Pap. Mich. Acad. Sc. 19 (1934) 158. — Type: Rahmat Si Toroes 161 (A holo, NY), Sumatra.

Tendrilled liana; young branches brownish villous. *Leaves*: stipules broadly ovate to auriculate, 5–7 mm, tomentose on both sides; petiole brownish villous, 1.5–2.5 cm long; lamina rigid coriaceous, suborbicular to subreniform, 3.5–5 by 4–7.5 cm, bilobed 1/4–1/3; tip of lobes subacute to obtuse, base cordate; 9–11-nerved; upper surface glabrous, lower densely reddish brown velvety. *Inflorescences* lateral and terminal, short pyramidal, few-flowered, dense racemes, up to 5 cm long; whole inflorescence reddish brown velvety; pedicels very short, thick, 2–3 mm; bracts orbicular to ovate with acute tip, up to 9 mm, outside ferrugineous villous, inside glabrous; bracteoles similar but slightly smaller. *Buds* obovoid, 10–15 mm, densely ferrugineous villous. *Hypanthium* short, thick, cup-shaped, c. 5 mm long. *Calyx* splitting into 5 reflexed, strap-shaped sepals, glabrous inside, 15 by 4 mm. *Petals* subequal, elliptic to obovate-oblong, c. 2 cm long, short-clawed, outside densely silky ferrugineous pubescent, inside glabrous. *Stamens* 3 fertile, filaments glabrous, c. 12–15 mm long; anthers ellipsoid, c. 6 mm; staminodes 2, filiform, 5–10 mm. *Ovary* shortly stipitate, c. 7 mm long, densely reddish brown velvety as is the c. 7 mm long style; stigma small, peltate. *Pods* oblong-obovate, base acute, apex obtuse, shortly apiculate, c. 6 by 3 cm, pubescent when young, later glabrous. *Seeds* 1 (or 2), flat, suborbicular, c. 18 mm long.

Distribution — *Malesia*: Sumatra (Eastcoast).

Notes — 1. *Bauhinia rahmatii* is a very distinct species. De Wit regards it as synonymous with *Phanera dasycarpa* Miq. but this is a name given to a single specimen collected by Teijsmann from Sumatra. The holotype in U consists of one sterile branch and a loose, woody-valved pod, c. 25 by 6 cm, without seeds; the valves are brownish velutinous. The texture and indumentum of the leaves, however, do not suggest this to be identical with *B. rahmatii*, so we are not able to place this collection with certainty.

2. *Bauhinia rahmatii* may be related to *B. ridleyi*.

38. *Bauhinia ridleyi* Prain

Bauhinia ridleyi Prain, J. As. Soc. Beng. 66, ii (1897) 185; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 16; in Fl. Thailand 4 (1984) 34, f. 8/3–4. — *Phanera dasycarpa* Miq. var. *ridleyi* (Prain) de Wit, Reinwardtia 3 (1956) 450. — Type: *Ridley s.n.* (K lecto), Penang I.

Tendrilled climber; all young parts rusty woolly pubescent. *Leaves*: stipules ovate-lanceolate, falcate, c. 3 mm; petioles densely woolly pubescent, 1–2 cm; lamina ovate-oblong, 5–8 by 4–6.5 cm; 9–11-nerved; bifid 1/3–1/2 with rather narrow sinus; tip of lobes subacute to obtuse; base truncate to cordate; upper surface brownish hirsute; lower rusty hirsute. *Inflorescences* terminal, short pyramidal, dense-flowered racemes up to 4 cm; pedicels stout, 3–7 mm; bracts ovate, acute, 4–7 mm; bracteoles similar, smaller. *Buds* obovoid, c. 15 by 7 mm. *Hypanthium* broadly tubular, slightly dilated at base, 8–10 mm long. *Calyx* splitting into 5 free, \pm reflexed sepals. *Petals* white, narrowly obovate to oblong, obtuse, 15–20 mm long, short-clawed, densely silky tomentose outside. *Stamens* 3 fertile; filaments sparsely hairy, 2 cm long; anthers c. 7 mm long; staminal nodes 2, c. 1 cm. *Ovary* densely reddish brown tomentose, 10–12 mm including a short stipe; style thick, 5 mm; stigma large, peltate, 2–3 mm, hairy as ovary. Mature *Pods* not seen; young pods strap-shaped, 8 by 3 cm, glabrous except at suture, with a 5 mm beak.

Distribution — Thailand (Narathiwat), Peninsular Malaysia (Penang I., Kedah, Perak, Kelantan).

Habitat — Evergreen forests at low altitude.

39. *Bauhinia semibifida* Roxb.

Bauhinia semibifida Roxb. [Hort. Beng. (1814) 31, nomen], Fl. Ind., ed. Carey, 2 (1832) 330; ed. Clarke (1874) 348; Wall., Pl. As. Rar. 3 (1832) pl. 253; Wight., Ic. Pl. 1, 14 (1840) pl. 263; Baker in Hook. f., Fl. Brit. India 2 (1878) 280; Prain, J. As. Soc. Beng. 66, ii (1897) 182, 184, 185, 499, 502; Gagnep. in Fl. Indo-Chine 2 (1913) 130; Ridley, Fl. Malay Penins. 1 (1922) 627; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19, 20. — *Phanera semibifida* (Roxb.) Benth. in Miq., Pl. Jungh. (1852) 263; Miq., Fl. Ind. Bat. 1, 1 (1855) 61; de Wit, Reinwardtia 3 (1956) 465. — Type: Unpublished Roxburgh plate no 1967, in K.

Phanera sumatrana Miq., Fl. Ind. Bat. 1 (1858) 1078. — Type: *Teijsmann HB 858* (U holo), Siboga.

Bauhinia stenostachya Baker, Kew Bull. (1896) 22. — *Phanera semibifida* var. *stenostachya* (Baker) de Wit, Reinwardtia 3 (1956) 468. — Type: *Creagh s.n.* (K lecto), Sabah.

Bauhinia perkinsae Merr., Bull. Govt. Lab. Philipp. 17 (1904) 21. — Type: *Merrill 731* (NY lecto; K), Palawan.

Bauhinia borneensis Merr., Philipp. J. Sc., Bot. 11 (1916) 78. — Type: *Native collector 1906* (A holo), Sarawak.

General note — This is the most widely distributed species of the Malesian *Bauhinias* and a great many collections have been available to us. It is a highly polymorphous species, composed of numerous isolated populations. There is, however, a continuous variation from small to large leaves with a varying indumentum and varying bud shapes with long to short hypanthium. We have separated some of the more remarkable local ‘types’ as varieties. Local floras may well in the future distinguish more, and some may even be tempted to treat these as species, as has been the case with, e.g., *B. perkinsae* and *B. stenostachya*.

The best character for recognizing *Bauhinia semibifida* is the distinctly dilated hypanthium.

Bauhinia excurrens Stapf, regarded as a variety by De Wit, is treated as a separate species and *B. subglabra* Merr. is regarded as belonging to *B. atherniana* Perkins, which undoubtedly is a closely related species.

Besides the varieties described below some of the variations are worthwhile mentioning. The stigma is usually large and peltate; from Sabah we have measured 8 mm in diameter in a herbarium specimen. Also the anthers are large and 15 mm is the largest measure, again from Sabah. The hypanthium varies quite a lot, it measures usually c. 10 mm, in large-flowered specimens from N Borneo we have measured 15 mm, lengthening to 20 mm after anthesis. We have found a collection from Sumatra with a long hypanthium and a small, almost capitate stigma; while in the Philippines the hypanthium tends to be short, 5–6 mm and only slightly dilated; this is combined with generally smaller flowers. The great majority of all the collections, however, falls within var. *semibifida*, first of all characterized by the tubular hypanthium dilated at the base. The flowers are white, turning yellowish or yellowish green, and the stigma is large and peltate, oblique.

KEY TO THE VARIETIES

- 1a. Hypanthium 5–10(–15) mm long, tubular, dilated at base; leaves with tip of lobes obtuse to acuminate; indumentum varying 2
- b. Hypanthium shorter, 5 by 4 mm, ± urceolate; leaves finely reddish brown pubescent below, tip of lobes obtuse **c. var. bruneiana**
- 2a. Bracts large, 20–30 mm; young branches patently hairy; leaves reddish villous beneath **d. var. longebracteata**
- b. Not this combination 3
- 3a. Leaves on flowering shoots 4–11 cm across, rarely more 4
- b. Leaves on flowering shoots larger, 11–18 cm across 5
- 4a. Leaves glabrous to glabrescent below; divided 1/4–1/2, tip of lobes obtuse to subacute, rarely acute **a. var. semibifida**
- b. Leaves densely dark brown appressed hairy below, deeply divided, 2/3–3/4, lobes narrowly triangular, tip acuminate **b. var. acuminata**
- 5a. Inflorescences racemes 20–30 cm long **f. var. stenostachya**
- b. Inflorescences corymbose to racemose, up to 20 cm long **e. var. perkinsae**

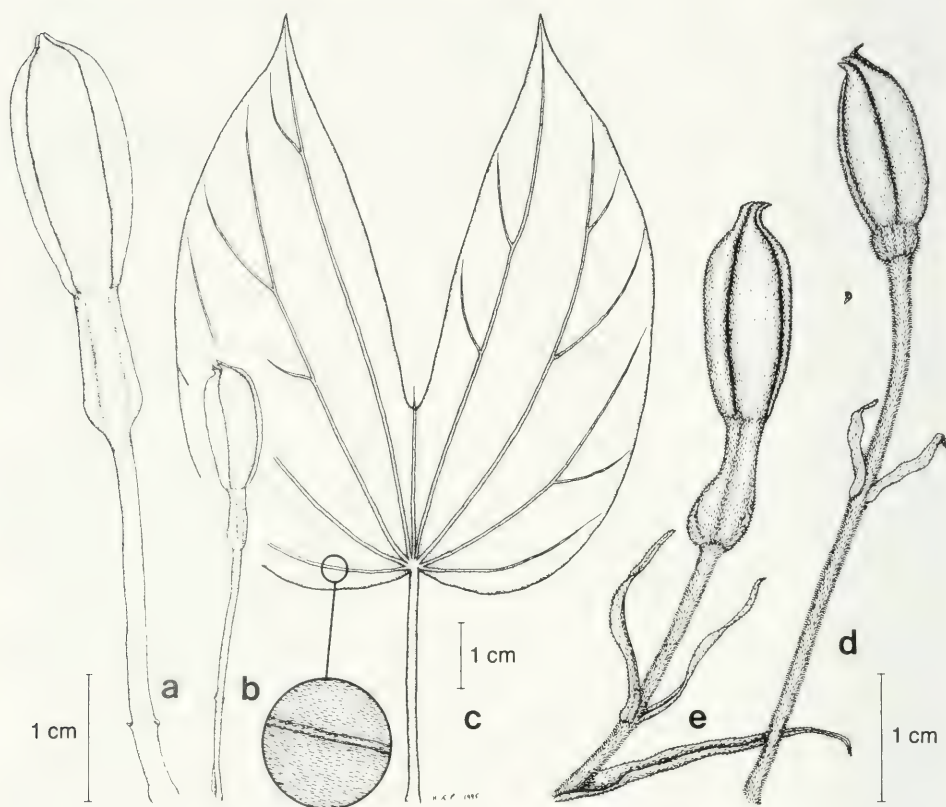


Fig. 11. *Bauhinia semibifida* Roxb. var. *semibifida*. a, b. Flower buds (Talip 52823, Aban & Kodoh SAN 81875). — *Bauhinia semibifida* Roxb. var. *acuminata* K. & S.S. Larsen. c. Leaf and detail lower surface (Krispinus SAN 105335). — *Bauhinia semibifida* Roxb. var. *bruneiana* K. & S.S. Larsen. d. Flower bud (van Niel 3455). — *Bauhinia semibifida* Roxb. var. *longebracteata* K. & S.S. Larsen. e. Flower bud (Veldkamp 8586). Drawing H.Æ. Pedersen.

a. var. *semibifida*

Phanera sumatrana Miq. — *Bauhinia borneensis* Merr.

Tendrilled climber, young branches brownish pubescent, later glabrous. *Leaves*: stipules auriculate to orbicular, c. 5 by 2 mm, glabrous or nearly so; petiole 2–6 cm, pubescent to glabrous, lamina obovate-orbicular, 4–11 cm diam.; (9–)11–13-nerved; bifid 1/4–2/5, tips of lobes obtuse (to acute), base cordate; upper surface glabrous, lower glabrous to glabrescent. *Inflorescences* terminal or lateral, short or long racemes with pubescent axis; pedicels pubescent, 3–6 cm; bracts lanceolate, silky puberulous, 5–8 mm, very early caducous; bracteoles linear-acute, c. 8 mm. *Buds* ellipsoidal, clavate, mostly pubescent, 10–24 mm long. *Hypanthium* tubular, 5–10(–15) mm long, with dilated base. *Calyx* early splitting into 5 reflexed, strap-shaped sepals, 1–2.5 cm

long. *Petals* white turning yellow, unequal, elliptic to oblong, glabrous except for the pubescent claw, and sometimes sparsely hirsute externally along the median line, 2–3 (–3.5) cm long, claw 2–5 mm. *Stamens* 3 fertile; filaments 2.5–3 cm, glabrous, stout; anthers oblong, 1 cm; staminodes 2 or 3, small, filiform. Stipe of *ovary* c. 3 mm, ovary c. 10 mm, style stout, c. 5 mm, all entirely densely brown silky tomentose; style increasing towards the very large, oblique, peltate stigma, up to 5 mm across, much lengthening after anthesis. *Pods* strap-shaped, flat, smooth, oblong, glabrous, 10–20 by 3–4 cm, beak 5–10 mm. *Seeds* c. 6, flat, varying in size. — **Fig. 11a, b.**

Distribution — *Malesia*: Sumatra, Malay Peninsula, Borneo, Philippines, Celebes. One of the most widespread species in the genus.

Habitat — In margin of forests, 200–2000 m altitude.

Uses — Powder of roots used for medicinal purposes.

b. var. *acuminata* K. & S.S. Larsen

Bauhinia semibifida Roxb. var. *acuminata* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 660. — Type: *K. Fidilis* SAN 105335 (K holotype; SAN), Sabah.

The deeply divided leaves, 2/3–3/4 with broad sinus and narrowly triangular lobes with acuminate tips are the easily distinguishing characters of this variety. Lamina 4.5–10 by 4–7 cm, the undersides are densely dark brown appressed hairy. The buds are clavate, 13–14 mm, hypanthium 5–7 mm. Petals are narrow lanceolate, 15–20 mm including the thin, 4–5 mm long claw. — **Fig. 11c.**

Distribution — *Malesia*: N Borneo. Type from Sabah (Sepulut), another collection from NE Borneo (Berau, Mt Njapa).

Habitat — No data available.

Note — On the holotype the petals are described as 'reddish/yellow'; this should be studied in nature as all other varieties have white petals turning yellowish.

c. var. *bruneiana* K. & S.S. Larsen

Bauhinia semibifida Roxb. var. *bruneiana* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 660. — Type: *van Niel* 3455 (L), Brunei.

All young parts are covered with short, ferruginous hairs. The leaves on sterile shoots are divided 1/2, tip of lobes obtuse, 7-nerved, 7.5–12 by 7–11.5 cm; on flowering shoots smaller, 1/3–1/2 divided, 3–4.5 by 3–5 cm, finely reddish pubescent beneath. Inflorescence ferruginous velvety; bracts narrow linear-lanceolate to acuminate, 10–12 mm; bracteoles much narrower; pedicels 6–7 cm; hypanthium ± urceolate, 5 by 4 mm; buds club-shaped, 2–3 cm, with short, free tips of the sepals. Petals ferruginous silky hairy outside along the midline. — **Fig. 11d.**

Distribution — *Malesia*: Borneo (Brunei, Sabah and Sarawak).

Habitat — Lowland evergreen forest.

Note — The type is from Brunei; one collection from Sabah has a similar indumentum, but petals are less hairy and the larger leaves have more acute lobes; this is also the case with a collection from near Kuching.

d. var. *longebracteata* K. & S.S. Larsen

Bauhinia semibifida Roxb. var. *longebracteata* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 660. — Type: *Winkler 176* (HBG holo; AAU, L), W Kalimantan.

This variety is recognizable by its young branches being shaggy and patently ferruginous hairy. The bracts are narrowly lanceolate to linear, 2–3 cm, tardily caducous. Leaves are rather thin reddish villous beneath. The petals are narrowly lanceolate, silky hairy on the outer side. The stigma is smaller than in the other varieties. — **Fig. 11e.**

Distribution — *Malesia*: Borneo. The type is from W Borneo (Melaku) and there is one more collection from Central Borneo (Bukit Raja).

Habitat — Disturbed dipterocarp forest at low altitude.

e. var. *perkinsae* (Merr.) K. & S.S. Larsen

Bauhinia semibifida Roxb. var. *perkinsae* (Merr.) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 661. — *Bauhinia perkinsae* Merr.

Resembles var. *stenostachya* but has shorter, corymbose to racemose inflorescences, smaller flowers and a shorter hypanthium. The leaves are densely reddish brown hairy, particularly when young.

Distribution — *Malesia*: Philippines, endemic to Palawan where a dozen collections have been made.

Habitat — At low altitudes on sandy soil.

f. var. *stenostachya* (Baker) K. & S.S. Larsen

Bauhinia semibifida Roxb. var. *stenostachya* (Baker) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 661 — *Bauhinia stenostachya* Baker — *Phanera semibifida* var. *stenostachya* (Baker) de Wit.

Leaves large, 1/4–1/3 bifid, 13–17-nerved, up to 18 cm across; base deeply cordate; upper surface glossy, lower dark brown woolly pubescent, sometimes only on the nerves. Inflorescences long, narrow, many-flowered racemes, 20–35 cm; the pedicel sturdy, up to 4 cm, hairy; bracts narrowly lanceolate, c. 10 mm; bracteoles narrower and smaller. Buds clavate, apiculate, up to 2 cm. Hypanthium 10–13 mm, grooved, silky brown pubescent.

Distribution — *Malesia*: Borneo (Sabah, Sarawak).

Habitat — Primary forests at low altitudes, riverbanks.

Note — The type is from Sabah; two collections of Clemens from Sarawak are referred to this variety even if they are more glabrous.

40. *Bauhinia steenisii* K. & S.S. Larsen

Bauhinia steenisii K. & S.S. Larsen, Nord. J. Bot. 11 (1991) 630. — Type: *Kanis 50115* (L holo; K, SAN), Mt Kinabalu.

Large, tendrilled climber; young branches terete, coppery velvety tomentose, soon glabrous. *Leaves*: stipules small, broadly ovate, silky hairy, very early caducous, 3–4



Fig. 12. *Bauhinia steenisii* K. & S.S. Larsen. a. Flowering twig; b. flower bud; c. fruit (a: *Kanis* 50115; b: *Chew et al.* 2877; c: *Chew & Corner* 4279). Drawing K. Tind.

mm; petiole rusty velutinous, 2–3 cm; lamina suborbicular to reniform, often notably broader than long, 5–7 by 6–9.5 cm; bifid 1/3; tip of lobes obtuse, base deeply cordate, 11–13-nerved; upper surface glabrous, glossy, lower ferrugineous pubescent. *Inflorescences* terminal, short, few-flowered racemes; axis 3–4 cm, densely coppery velutinous; pedicels stout, c. 4 cm long, densely tomentose; bracts narrow lanceolate, silky hairy, 3–4 mm, early caducous; bracteoles minute, inserted about the middle of the pedicel. *Buds* clavate-ellipsoid with 10 longitudinal, prominent ridges, 2.5–3 by c. 1 cm, densely coppery velutinous. *Hypanthium* tubular, striate-furrowed, 10–15 mm. *Calyx* splitting into 5 eventually reflexed, strap-shaped sepals, hairy on both sides except for the base of the inner side. *Petals* white turning deep yellow, silky ferrugineous outside, glabrous inside, unequal from narrow to broadly obovate-lanceolate, with more or less distinct, short claw, 3–4 cm long. *Stamens* 3 fertile; filaments red, c. 4.5 cm, glabrous; anthers 7 mm; staminodes 2, subulate, c. 1 cm. *Ovary* stipitate; stipe 10–15 mm; ovary 10–12 mm; style c. 20 mm, all densely coppery woolly pubescent; stigma small, capitate, c. 2 mm. — **Fig. 12.**

Distribution — *Malesia*: Borneo, only known from Mt Kinabalu.

Habitat — Several collections are known, all from altitudes between 1700 and 1800 m.

Note — This remarkable species was first collected by J. & M.S. Clemens in 1932 and since then repeatedly collected on Mt Kinabalu. It has been misidentified as *Bauhinia excelsa* or *B. semibifida* from which it is readily distinguished by its 10-ridged buds and the small stigma; it may have some resemblance to *B. fabrilis* from the lowland rain forest of N Borneo; from the latter species, however, it is distinct by the small and differently shaped leaves, the minute stipules and bracts, and finally the prominent ridged buds.

41. *Bauhinia stipularis* Korth.

Bauhinia stipularis Korth., Kruidk. (1841) 92. — *Phanera stipularis* (Korth.) Benth. in Miq., Pl. Jungh. (1852) 263; Miq., Fl. Ind. Bat. 1, 1 (1855) 65; de Wit, Reinwardtia 3 (1856) 469. — Type: *Korthals s.n.* (L lecto; K, PR, U), Sumatra.

Phanera albolutea Miq., Fl. Ind. Bat. 1, 1 (1858) 1079. — *Bauhinia albolutea* (Miq.) Prain, J. As. Soc. Beng. 66, ii (1897) 181; Ridley, J. Fed. Mal. St. Mus. 8 (1917) 30. — Type: *Teijsmann HB 857* (U), Sumatra.

Phanera nicobarica Balakr. & Thoth., Bull. Bot. Surv. India 17 (1975) 201. — Type: *Balakrishnan 3043A* (CAL holo; PBL), Great Nicobar.

KEY TO THE VARIETIES

- a. Style slender, glabrous, 15–20 mm long **a. var. *stipularis***
- b. Style robust, rusty pubescent, 5–7 mm long **b. var. *brachystylus***

a. var. *stipularis*

Phanera albolutea Miq. — *Phanera nicobarica* Balakr. & Thoth.

Large, tendrilled *climber*; young branches rusty tomentose, soon glabrescent. *Leaves*: stipules suborbicular to reniform, 4–6 mm diam., pubescent outside; petiole 3–5 cm, slender, glabrescent; lamina suborbicular, 6–7 cm diam., 9–11-nerved, bifid 1/4–1/3 with wide sinus; tip of lobes acute-subacute, rarely obtuse, base cordate; upper surface glabrous, lower thinly pubescent. *Inflorescences* terminal, corymbose on short, leafy shoots; pedicels slender, 3–4(–5) cm long, striate, pubescent; bracts narrowly triangular, with long acute apex, 4–5 mm; bracteoles shorter, linear. *Buds* clavate-ellipsoid, apiculate, brownish tomentose to nearly glabrous, 15–20 mm long. *Hypanthium* tubular, 6–10 mm, striate, somewhat dilated at base. *Calyx* splitting into 5 reflexed, strap-shaped sepals, glabrous inside. *Petals* white turning yellowish, almost equal, outside sparsely pilose along the middle zone, inside hairy along the midrib to nearly glabrous, blade oblong with acute apex, some of them with auriculate base, 15–25 by 8–12 mm, claw distinct, 5–7 mm. *Stamens* 3 fertile; filaments pale red, glabrous, 20–30 mm; anthers 6–8 mm; staminodes 2, filiform, 7–12 mm. *Ovary* c. 5 mm, brownish silky pubescent, on an equally long, silky pubescent stipe; style glabrous, c. 15 mm long; stigma capitate, 1.5–2 mm diam. *Pods* oblong, glabrous, woody, brown, c. 15 by 4 cm. *Seeds* 4 or 5, flat, suborbicular, 10–15 mm diam.

Distribution — Nicobar Islands; *Malesia*: Sumatra and islands W of the Malay Peninsula; not recorded from the mainland.

Habitat — From the lowland up to 1700 m altitude on Sumatra (Mt Kerinci), also collected along mangrove swamp.

Note — It is characteristic for this and the related species *Bauhinia lingua* that well developed stipules occur under the inflorescence; they could be mistaken as bracts. We have studied the recently described *B. nicobarica* and found that it in no way differs from *B. stipularis*. The type was collected in the same area as *B. albolutea* (Miq.) Prain.

b. var. *brachystylus* K. & S.S. Larsen

Bauhinia stipularis Korth. var. *brachystylus* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 659. — Type: van Borssum Waalkes 2552 (L holotype; BO, K), Sumatra.

Deviates from var. *stipularis* by the shorter filaments, 10–15 mm, and shorter pistil: stipe 3–5 mm, ovary 4–6 mm, style 5–7 mm, all densely rusty pubescent. The bud shape is also somewhat narrower and the hypanthium shorter.

Distribution — *Malesia*: N and C Sumatra.

42. *Bauhinia sylvani* (de Wit) Cusset

Bauhinia sylvani (de Wit) Cusset, Adansonia, n.s., 6 (1966) 278; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 19. — *Phanera sylvani* de Wit, Reinwardtia 3 (1956) 438. — Type: Endert 4060 (BO holotype; L), Kalimantan.

Giant *liana* with up to 60 m tall stems. Young branches brown woolly, strongly angulate and longitudinally grooved; tendrils densely brownish hairy. *Leaves*: stipules foliaceous, auriculate-orbicular, densely hairy outside, thinly pubescent inside, up to 2.5 cm diam.; petiole stout, brown woolly, up to 7 cm long; lamina ovate rotundate, 8–20 cm diam.; 15–17-nerved; bifid c. 1/4–1/3 with \pm broad sinus; tip of lobes rounded; base very deeply cordate; upper surface almost glabrous except for the very base where the petiole is inserted; lower surface woolly-tomentose; connecting nerves strongly marked, perpendicular to the main nerves. *Inflorescences* stout, terminal racemes, densely brown tomentose with axis up to 25 cm long, 5–7 mm thick, angular, c. 10-flowered; pedicels tomentose, 4–5 mm thick, 1.5–6 cm long, gradually merging into the 7–10 cm long hypanthium; bracts ovate, 10–15 mm long, caducous; bracteoles lanceolate, c. 10 mm, inserted at the base of the hypanthium. *Buds* ellipsoid-clavate, velvety brown, 2.5–4 by 1–1.5 cm. *Calyx* splitting into 5 reflexed, strap-shaped lobes, hairy on both sides. *Petals* creamy yellow, obovate, somewhat differing in size, the upper smaller than the lateral, 5–6 by 2–2.5 cm, densely velvety outside, sparsely hairy inside; claw 1–2 cm long. *Stamens* 3 fertile, yellowish green; filaments 6–7 cm long, anthers c. 1 cm long; staminodes 2, c. 1 cm long. *Ovary* reddish-brownish hairy, stipe c. 1 cm, angulate, ovary c. 2 cm; style recurved, c. 1 cm, hairy except for the very apical part; stigma large, peltate, 3–4 mm diam. *Pods* dehiscent, strap-shaped, 30–40 by 6–7 cm, densely rusty tomentose. *Seeds* c. 10, flat, elliptic-ovate to orbicular, 2.5–3 cm diam.

Distribution — *Malesia*: endemic to Borneo where it has been collected in a few localities in Sarawak (districts Kutei, Temiai and Kakus), and in Sabah (district Tenom).

Habitat — Along riverbanks in primary forests and mixed dipterocarp forests at altitudes between 200 and 450 m.

Section *Austrocercis*

Bauhinia sect. *Austrocercis* (de Wit) Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 21. — *Phanera* subg. *Austrocercis* de Wit, Reinwardtia 3 (1956) 527.

Tendrilled lianas. *Leaves* entire, emarginate or shortly bifid. *Hypanthium* cupulate. *Calyx* bilabiate, upper lobes of 2 fused sepals, later splitting; lower lobe of 3 fused sepals; a digitate fleshy body representing staminodes on adaxial rim of hypanthium; nectariferous disc absent. Fertile *stamens* 3 anterior; staminodes 2, minute; anthers short, broad, opening by a longitudinal slit. *Pods* dehiscent, woody. *Seeds* with short, funicular aril-lobes.

Distribution — One species in New Guinea.

43. *Bauhinia williamsii* F. Muell.

Bauhinia williamsii F. Muell., Descr. Notes Papuan Pl. 4 (1876) 61; F.M. Bailey, Queensl. Agric. J. 24 (1910) 21. — *Phanera williamsii* (F. Muell.) de Wit, Reinwardtia 3 (1956) 528. — Type: *Goldie s. n.* (n.v.), near Port Moresby.

Large climber with flattened, undulate stems; young branches reddish pubescent, sulcate, later glabrous; tendrils usually solitary, reddish, silky-hairy when young. *Leaves*: stipules lanceolate, 3–4 mm, early caducous; petiole 4–6(–8) cm long; lamina broadly ovate, often broader than long, entire, emarginate or bifid, up to 9 by 11 cm; 5–7-nerved; apex rounded to acute, when bifid, tip of lobes acuminate; base \pm deeply cordate to almost truncate; upper surface shining, sparsely hairy to subglabrous; lower densely reddish hirsute when young, later almost glabrous. *Inflorescences*: flowers in large, open, panicles composed of dense-flowered racemes; axis reddish brown silky-hairy, 5–15 cm long, pedicel c. 1 cm; bracts linear-subulate, recurved, 2–3 mm; bracteoles minute, inserted at about the middle of the pedicel. *Buds* ovoid-clavate, reddish brown silky-hairy, 7–8 mm including the c. 4 mm long, cup-shaped, faintly ribbed hypanthium. *Calyx* bilabiate, silky-hairy outside, the posterior lobe reflexed. *Petals* ovate-spathulate, subequal, 5–6 mm long, bright red, silky hairy outside, sparsely pubescent inside; claw short but distinct. *Stamens* 3 fertile; filaments stout, 7–10 mm, pink; anthers ellipsoid, c. 2 mm long, red; 2 anterior staminodes minute; 5 posterior forming a dark red, fleshy body at the rim of the hypanthium. *Ovary* 7 mm, sessile, reddish brown silky-hairy, gibbous at base; style c. 4 mm, hairy, glabrous in upper part; stigma indistinct. *Pods* elliptic, 5–11 by 3 cm, glabrescent. *Seeds* 2 or 3, flat, orbicular, c. 1.5 cm diam.

Distribution — *Malesia*: New Guinea, endemic to the SE part (seemingly frequent).

Habitat — A rain forest species trailing from medium to high trees; from sea level up to 100 m altitude.

Section *Lasiobema*

Bauhinia sect. *Lasiobema* (Korth.) Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 576; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 18. — *Lasiobema* Korth. (without rank), Verh. Nat. Gesch. Ned. Bezitt. Bot. (1841) 84. — *Lasiobema* (Korth.) Miq., Fl. Ind. Bat. 1, 1 (1855) 71; de Wit, Reinwardtia 3 (1956) 422, p.p.

Tendrilled *lianas*. *Leaves* entire, emarginate or bilobed. *Hypanthium* turbinate. *Calyx* remaining entire or splitting irregularly into 2–5 segments; nectariferous disc present. Fertile *stamens* 3; staminodes minute; anthers elliptic, opening by a longitudinal slit. *Pods* dehiscent or tardily dehiscent, thin-valved or woody. *Seeds* with short funicular aril-lobes.

Distribution — About 15 species in S and SE Asia.

KEY TO THE SPECIES

- 1a. Large liana with broad flat, undulated main stems; inflorescence a very large panicle; buds spherical rounded; petals creamy-white **46. *B. scandens***
- b. Thin-stemmed climber; inflorescence a simple raceme or 2 or 3 together; buds ovoid-acute; petals yellowish green 2
- 2a. Pedicels c. 20 mm long; stamens 5 mm long **44. *B. curtisii***
- b. Pedicels c. 5 mm long; stamens c. 10 mm long **45. *B. flava***

44. *Bauhinia curtisii* Prain

Bauhinia curtisii Prain, J. As. Soc. Beng. 66, ii (1897) 195; Ridley, Fl. Malay Penins. 1 (1922) 633; Craib, Fl. Siam. Enum. 1 (1928) 518; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 9; in Fl. Camb., Laos & Vietnam 18 (1980) 170, pl. 33/9–12; in Fl. Thailand 4 (1984) 24, f. 6/10–13. — *Lasiobema curtisii* (Prain) de Wit, Reinwardtia 3 (1956) 424; Hô, Illus. Fl. S. Viêt-nam, ed. 2, 1 (1970) 814, f. 2055. — Type: *Curtis 1682* (K holo), Langkawi I.

Bauhinia calcicola Craib, Kew Bull. (1927) 387; Fl. Siam. Enum. 1 (1928) 519. — Type: *Kerr 7718* (K holo; ABD, BK, C, E, S), Thailand.

Tendrilled *shrub* or *climber*; young branches greyish puberulous, later glabrous, glossy. *Leaves*: stipules minute, ovate-acute, glabrous; petiole \pm pubescent, 1–3.5 cm; lamina broadly ovate to ovate-oblong, 5–7 by 2.5–6 cm, 5–7-nerved; entire to emarginate or bifid 1/5 with broad sinus; tips of lobes acute to subacute, base rounded to shallowly cordate; upper surface subglabrous, glossy, lower pubescent to subglabrous. *Inflorescences*: lateral and terminal, mainly unbranched, lax-flowered racemes, 10–20 cm long; main axis greyish pubescent; pedicels capillary, to 2 cm long; bracts 1–2 mm long; bracteoles minute, inserted at about the middle of the pedicel. *Buds* ovoid-acute, greyish pubescent, 2–3 mm long. *Hypanthium* very short turbinate. *Calyx* splitting into 2 or 3 segments. *Petals* greenish, 5–7 mm, unequal, 2 lower spatulate, 3 upper very narrow, claw 2–3 mm. *Stamens* 3 fertile; filaments 4–5 mm; anthers oblong; staminodes 2, minute. *Ovary* glabrous, shortly stipitate, c. 2 mm, emerging laterally from the yellow, glabrous disc; style 1–2 mm; stigma inconspicuous. *Pods* dehiscent, strap-shaped, 5–6 by 1.5 cm, glossy, smooth, thin-valved with a short, curved beak. *Seeds* 2–6, flat, c. 1 cm diam.

Distribution — Cambodia, Laos, Vietnam, Thailand; *Malesia*: Malay Peninsula.

Habitat & Ecology — Margin of evergreen forests, mostly on wet soil, up to 500 m altitude; seems to be restricted to limestone. In clearings it is often spreading and becoming a low shrub.

45. *Bauhinia flava* (de Wit) Cusset

Bauhinia flava (de Wit) Cusset, Andansoniana, n.s. 6 (1966) 278. — *Lasiobema flavum* de Wit, Reinwardtia 3 (1956) 425, f. 8. — Type: *Henderson SF 29146* (K holotype; L, SING).

Tendrilled climber; young branches rusty puberulous, later glabrous. *Leaves*: stipules early caducous (not seen); petiole 3–5 cm, glabrescent; lamina ovate to orbiculate, 6–16 by 7–17 cm, 9-nerved; bifid 1/3–2/3 with wide sinus; tip of lobes subacuminate; base cordate; upper surface glabrous except near the base; lower glabrescent, puberulous between the nerves near the petiole. *Inflorescences* usually lateral, simple or branched many-flowered racemes up to c. 20 cm with brownish pubescent axis; pedicels pubescent, c. 5 mm long; bracts oblong acute, c. 2 mm long; bracteoles similar but shorter, inserted below the middle of the pedicel. *Buds* ovoid, subacute, brownish pubescent, c. 3 mm. *Hypanthium* very shallow. *Calyx* splitting into 2 (or 3), finally 5 reflexed segments, c. 4 mm long. *Petals* pale yellow, obovate to broadly elliptic, gradually tapering toward the claw, externally golden pubescent, c. 8 mm long. *Stamens* 3 fertile; the filaments glabrous, 6–8 mm; anthers ellipsoid, c. 0.5 mm; staminodes minute, subulate. *Ovary* glabrous, 3 mm; the stipe c. 1 mm long, arising from the disc; style glabrous, c. 2 mm; stigma inconspicuous. *Pods* dehiscent, strap-shaped, 6–8 by 1.5 cm, glabrous. *Seeds* 3–6, flat, orbicular, 1 cm diameter or below (only one not quite ripe seed seen).

Distribution — *Malesia*: endemic to Langkawi I. and the adjacent coast of Perlis. Only three collections seen.

Habitat — On limestone at sea level.

46. *Bauhinia scandens* L.

Bauhinia scandens L., Sp. Pl. 1 (1753) 344; Burm., Fl. Ind. (1768) 94; Prain, J. As. Soc. Beng. 66, ii (1897) 94; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 737; Bandyopadhyay & Thothathri, J. Econ. Tax. Bot. 17 (1993) 693. — *Phanera scandens* (L.) Raf., Sylv. Tellur. (1838) 122; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 21. — *Lasiobema scandens* (L.) de Wit, Reinwardtia 3 (1956) 427; Backer & Bakh. f., Fl. Java 1 (1964) 534; Hô, Illus. Fl. S. Vietnam, ed. 2, 1 (1970) 815, f. 2056. — Lectotype: Rheede, Hort. Malab. 3 (1688) pl. 30.

Bauhinia anguina Roxb., [Hort. Beng. (1814) 31, nom. nud.]; Pl. Coromand. 3 (1820) 82, pl. 285; Fl. Ind., ed. Carey, 2 (1832) 328; DC., Prodr. 2 (1825) 516; Wight & Arn., Prodr. (1834) 298; Baker in Hook. f., Fl. Brit. India 2 (1878) 284; Gagnep. in Fl. Indo-Chine 2 (1913) 138; Ridley, Fl. Malay Penins. 1 (1922) 634. — *Lasiobema anguinum* (Roxb.) Miq., Fl. Ind. Bat. 1, 1 (1855) 71. — Type: Roxb., Pl. Coromand. 3 (1820) pl. 285.

Bauhinia debilis Hassk., Tijds. Nat. Gesch. Phys. 10 (1843) 149. — *Phanera debilis* (Hassk.) Miq., Fl. Ind. Bat. 1, 1 (1855) 69. — To be typified.

Lasiobema horsfieldii Miq., Fl. Ind. Bat. 1, 1 (1855) 71. — *Bauhinia anguina* var. *horsfieldii* (Miq.) Prain, J. As. Soc. Beng. 66, ii (1897) 194; Gagnep. in Fl. Indo-Chine 2 (1913) 138. — *Bauhinia horsfieldii* (Miq.) Macbride, Contr. Gray Herb. 2 (1919) 23; Craib, Fl. Siam. Enum. 1 (1928) 522.

— *Lasiobema scandens* var. *horsfieldii* (Miq.) de Wit, Reinwardtia 3 (1956) 427; Hô, Illus. Fl. S. Viêtنام, ed. 2, 1 (1970) 815, f. 2057. — *Bauhinia scandens* var. *horsfieldii* (Miq.) K. & S. S. Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 16; in Fl. Camb., Laos & Vietnam 18 (1984) 168; in Fl. Thailand 4 (1984) 25. — Type: *Horsfield s.n.* (U lecto).

Bauhinia subrhombicarpa Merr., Lingn. Sci. J. 14 (1935) 9, t. 2. — Type: *Lau* 386 (NY holo; A, CAL, LU).

Large woody *liana*, 30–50 m, with \pm opposite tendrils; young branches brownish pubescent, later glabrous; old stems flattened, undulated, forming ‘monkey-ladders’. *Leaves*: stipules minute, falcate, mucronate, early caducous; petiole 1.5–5 cm, \pm pubescent to glabrous; lamina varying in shape from cordate entire to ovate to acute or emarginate, to deeply bilobed sometimes almost to the base or, on young basal shoots, consisting of 2 free leaflets, 5–12 by 6–10 cm, base cordate to truncate; 7-nerved; upper surface glossy, glabrous, lower sparsely hairy to glabrous. *Inflorescences* large panicles composed of many-flowered, narrow racemes, main axis rusty-pubescent; pedicels \pm puberulous, 2–4 mm; bracts setaceous, 2 mm long; bracteoles minute, variously inserted. *Buds* globose, 1–2 mm diam., puberulous. *Hypanthium* very short turbinate. *Calyx* cup-shaped with 5 teeth. *Petals* yellowish white, obovate, 2–3 mm long; claw very short. *Stamens* 3 fertile, filaments 4–5 mm long; anthers ellipsoid; staminodes 2, minute. *Ovary* glabrous, 1 mm; stipe 1 mm long, glabrous to hairy; style slender, glabrous, 1 mm long; stigma inconspicuous. *Disc* hairy. *Pods* tardily dehiscent, thin-valved, slightly turgid, \pm elliptic, glossy, glabrous, 3–4 by 1.5–2 cm. *Seeds* 1–3, oblong, c. 6 mm diam.

Distribution — From India to Burma and S China, Laos, Cambodia, Vietnam, and Thailand; *Malesia*: Sumatra, Java, Madura and Sumba.

Habitat & Ecology — This giant liana occurs from the lowland up to c. 800 m altitude (on Java); it seems to be most frequent on limestone. It prefers a seasonal climate and has not been reported from the evergreen forest of the Malay Peninsula; it is common all over Java.

Uses — Locally of medicinal value; also used for producing ropes.

Section *Lysiphyllum*

Bauhinia sect. *Lysiphyllum* Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 576; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 22. — *Lysiphyllum* (Benth.) de Wit, Reinwardtia 3 (1956) 431.

Bracteolanthus de Wit, Reinwardtia 3 (1956) 415.

Tournaya Schmitz, Bull. Jard. Bot. Nat. Belg. 43 (1973) 397.

Tendrilled *lianas* or semiscandent *shrubs* with tendrils (in Malesia). *Leaves* bifoliate (in Malesia) or entire. *Hypanthium* tubular or campanulate. *Calyx* split into 2, 3 or 5 lobes; nectariferous disc absent. *Stamens* 10; anthers opening by longitudinal slits. *Ovary* with peltate or capitate stigma. *Pods* woody, dehiscent or indehiscent. *Seeds* with short funicular aril-lobes.

Distribution — Tropical Africa, S Asia to N Australia, 9 species.

KEY TO THE SPECIES

- 1a. Leaflets small, c. 3 by 2 cm, apex rounded; hypanthium tubular, 5–8 mm **47. *B. binata***
- b. Leaflets large, 8–30 by 3.5–10 cm, apex acuminate; hypanthium campanulate, c. 3 mm 2
- 2a. Inflorescences woolly tomentose; bracts and bracteoles 7–10 mm, persistent **49. *B. diptera***
- b. Inflorescences glabrous; bracts and bracteoles minute, early caducous **48. *B. dewitii***

47. *Bauhinia binata* Blanco

Bauhinia binata Blanco, Fl. Filip., ed. 1 (1837) 331 ('*binnata*'); ed. 2 (1845) 231; ed. 3 (1878) 66; Merr., Philipp. J. Sc., Bot. 5 (1910) 43; Sp. Blanc. (1918) 172; Enum. Philipp. Flow. Pl. 2 (1923) 258; Craib, Fl. Siam. Enum. 1 (1928) 517; Meijer Drees, Comm. For. Res. Inst. Bogor 33 (1951) 68; Larsen & Larsen, Nat. Hist. Bull. Siam Soc. 25 (1973) 8; in Fl. Thailand 4 (1984) 22, f. 4/8–10; Nord. J. Bot. 2 (1982) 324; Bot. Helv. 93 (1983) 213; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 23. — *Lysiphyllum binatum* (Blanco) de Wit, Reinwardtia 3 (1956) 432, f. 10; Backer & Bakh. f., Fl. Java 1 (1963) 535. — Type: *Merrill Sp. Blanc.* 998 (L neo; K, W).

Bauhinia diphylla auct. non Ham.: Zoll., Nat. Geneesk. Arch. Neêrl. Indië 3 (1846) 70.

Phanera blancoi Benth. in Miq., Pl. Jungh. (1852) 264; Miq., Fl. Ind. Bat. 1, 1 (1855) 70. — *Bauhinia blancoi* (Benth.) Baker in Hook. f., Fl. Brit. India 2 (1878) 278; Perkins, Fragm. Fl. Philipp. 1 (1904) 8; Backer, Schoolfl. Java (1911) 413; Gagnep. in Fl. Indo-Chine 2 (1913) 144. — Type: *Cuming 1518* (E, PRC, W), Philippines.

Phanera complicata Miq., Fl. Ind. Bat. 1, 1 (1855) 70. — Type: *Zollinger s.n.* (U lecto), Java.

Tendrilled, erect, straggling *shrub*, up to 5 m high; branches greyish, glabrous. *Leaves*: stipules minute, scaly, early caducous; petiole slender, 15–25 mm, produced in a blunt, puberulous, caducous mucro; leaflets 2, free, obliquely ovate with broadly rounded apex and base, c. 3 by 2 cm, 4- or 5-nerved, glabrous on both sides. *Inflorescences* lateral and terminal corymbs developing into 5–6 cm long racemes with 10–12 flowers; pedicels c. 1 cm; bracts scaly, minute; bracteoles subulate, minute, inserted below the middle of the pedicel. *Buds* ovoid, pointed, finely pubescent. *Hypanthium* tubular, striate, 5–8 mm long. *Sepals* 5, lanceolate, acute, 5–6 mm long. *Petals* white to purplish with darker veins, c. 20 by 8 mm, narrowly obovate, short-clawed, woolly pubescent outside, less so inside. *Stamens* 10, red, subequal, filaments up to c. 2 cm long; anthers 3 mm long. *Ovary* stipitate, glabrous, 8–10 mm, stipe 2–3 mm; style red, 5 mm; stigma peltate. *Pods* strap-shaped, indehiscent, \pm curved, irregularly bulging, c. 20 by 3 cm, with rounded ends. *Seeds* 6–13, flat, shining, brown, trapezoid, 10 by 7 mm.

Distribution — Throughout the Malesian area to N Australia with a single occurrence in Thailand.

Habitat & Ecology — Restricted to the coastal area, in sandy soil as well as among rocks and in tidal forests; often common on small islands, rare in Java, and not reported from Sumatra or the Malay Peninsula; it seems to avoid the humid tropics and to prefer a seasonal climate.

Uses — Locally of medicinal use.

48. *Bauhinia dewitii* K. & S.S. Larsen

Bauhinia dewitii K. & S.S. Larsen, Gard. Bull. Sing. 31 (1978) 1; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 23. — Type: *Chai S 29920* (K holotype; L, SING), Borneo.

Large, tendrilled *liana*; young branches glabrous. *Leaves*: stipules early caducous (not seen); petiole 3–6 cm long, glabrous, produced into a 3–5 mm long mucro; leaflets 2, semicordate, 8–13 by 3.5–6.5 cm; tips acuminate 5–10 mm, base rounded; nerves 4, strongly developed and connected by several transverse secondary nerves; glabrous, shining on both surfaces. *Inflorescences* simple or compound lateral racemes up to 16 cm long, with thin glabrous axis; pedicels filiform, 1.5–2 cm long; bracts triangular, minute; bracteoles very minute, inserted below the middle of the pedicel. *Buds* obovoid-acute, c. 8 mm long including the 2–3 mm long, campanulate hypanthium. *Calyx* during anthesis splitting into 5 glabrous lobes. *Petals* white with reddish streaks, subequal, oblong, short-clawed, 10–12 by 8–10 mm. *Stamens* 10: 5 long with filaments c. 15 mm long, hairy in lower part, anthers 1.5 mm long, 5 short with filaments half as long and smaller anthers. *Ovary* hairy, on a 7 mm long, hairy stipe; style glabrous, 12 mm; stigma capitate. *Pods* unknown. — **Fig. 13.**

Distribution — *Malesia*: Borneo, endemic to Sarawak, only known from two collections (Kuching, Gunong Tieng and the type from foothill of Mt Doya).

49. *Bauhinia diptera* Miq.

Bauhinia diptera Blume ex Miq., Anal. Bot. 1 (1850) 12; Prain, J. As. Soc. Beng. 66, ii (1897) 501; Larsen & Larsen, Gard. Bull. Sing. 31 (1978) 1; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 22, 23. — *Phanera diptera* (Blume ex Miq.) Miq., Fl. Ind. Bat. 1, 1 (1855) 70. — *Bracteolanthus dipterus* (Blume ex Miq.) de Wit, Reinwardtia 3 (1956) 415. — Type: *Korthals s.n.* (L sh. 908.112–117 holotype), Borneo.

Bauhinia mirabilis Merr., Univ. Cal. Publ. Bot. 15 (1929) 102. — Type: *Elmer 21432* (A lectotype; BM, BR, M, SING, US), Borneo.

Large *liana* with coarse tendrils; young branches terete, glabrous. *Leaves*: stipules oblong, puberulous, 5–7 by 2 mm, early caducous; petiole 6–20 cm long, produced into a small, caducous mucro; leaflets 2, ovate-oblong, often strongly unequal-sided; apex short to long acuminate, 12–30(–40) by 7–10(–14) cm; nerves 4 or 5, strongly developed and connected by many conspicuous, straight, transverse, secondary nerves; glabrous on upper surface, thinly pubescent to almost glabrous on lower. *Inflorescences* lateral, usually simple racemes, 20–40 cm long, with stout, brownish tomentose axis; pedicels 5–25 mm, densely light brown tomentose; bracts large, ovate, up to 13 by 8 mm, tomentose particularly on the outer side; bracteoles similar, inserted on top of the pedicel and enclosing the bud. *Buds* ovoid, ridged, brownish tomentose, c. 10 mm including the c. 3 mm long, broad campanulate hypanthium. *Calyx* splitting into 2 or 3 ovate-acute lobes, c. 15 mm long, glabrous inside. *Petals* whitish, streaked with purple, subequal, ovate, woolly-tomentose outside, short clawed, c. 25 mm long. *Stamens* 10: 5 long with filament c. 25 mm, 5 short with filament c. 10 mm; filaments hairy at base; anthers ellipsoid, c. 5 mm. *Ovary* glabrous, 10–15 mm, on a 10–12 mm long stipe;



Fig. 13. *Bauhinia dewitii* K. & S.S. Larsen. a. Flowering twig; b. flower; c. male flower, opened; d. young flower bud; e. female flower, opened; f. petal (Chai 29920). Drawing B. Johnsen. Reproduced from Gard. Bull. Sing. 31.

style c. 10 mm; stigma small, capitate. *Pods* strap-shaped, broadest at apex, explosively dehiscent, glabrous, flat, up to 20 by 4.5 cm. *Seeds* c. 4, flat, orbicular, c. 2.5 cm diam.

Distribution — *Malesia*: endemic to the northern part of Borneo (see note).

Habitat — A large tree-top liana on the edges of streams at low altitudes.

Note — A sterile specimen, *Corner s.n.*, 5 Aug. 1939 (SING), collected in Johore, Bukit Tinjan Laut, belongs here; whether this has been introduced or is really indigenous here remains to be studied.

Section **Palmatifolia**

Bauhinia sect. *Palmatifolia* (de Wit) Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 22. — *Phanera* subg. *Biporina* de Wit sect. *Palmatifolia* de Wit, Reinwardtia 3 (1956) 492; sect. *Bifoliola* de Wit, l.c. 491; & sect. *Cinnamomifolia* de Wit, l.c. 519.

Tendrilled lianas. *Leaves* entire, bilobed or bifoliolate. *Hypanthium* campanulate, infundibuliform, turbinate or tubular. *Calyx* irregularly splitting during anthesis to mouth of hypanthium into 2 or 3, rarely 4 or 5 lobes, or regular in upper part only into 5 lobes (*B. campanulata*). *Petals* subequal to unequal; nectariferous disc absent. Fertile *stamens* 3; reduced stamens or staminodes usually present; anthers opening by a central pore in each theca. *Ovary* with capitate to peltate stigma. *Pods* dehiscent, woody- or thin-valved. *Seeds* with short, funicular aril-lobes.

Distribution — 18 species, all restricted to *Malesia*; *B. bidentata* occurs also in southernmost Thailand, south of the Isthmus of Kra.

Notes — 1. The species in section *Palmatifolia* are often less well defined than in the other sections. Floral characters are rather uniform but there are great variations in the inflorescence structure and in the size, texture, nervation and form of the leaves. We have maintained a rather conventional taxonomy of the group and avoided drastic lumping as well as splitting. It is possible that, after a closer study in nature, a different viewpoint could be defended. We have had to leave this to the future.

2. In more than one species of this section it has been noted that the pollen is released through the pore together with a drop of colourless fluid. This fluid is very viscous and dries very slowly; in some cases it has been observed that ants are attracted to this, and thus may play a role as pollinators.

KEY TO THE SPECIES

- 1a. Leaves consisting of 2 free or almost free leaflets 57. **B. foraminifer**
- b. Leaves otherwise 2
- 2a. Leaves emarginate, bitid or entire, orbicular, suborbicular, ovate or cordate, as long as broad or slightly longer, nerves (3–)5–11 3
- b. Leaves always entire, elliptic, lanceolate ovate, ovate-oblong, rarely cordate, usually one and a half times as long as broad or longer, sometimes slightly emarginate at the acute or acuminate apex, nerves 3–5, rarely 7 11

- 3a. Leaves, inflorescence, and floral parts glabrous except few hairs on stipules, bracts and bracteoles; leaves coriaceous, entire, cordate, 7–15 by 5–9 cm, often glaucous beneath, margin usually recurved when dry, petals greenish with red centre **64. B. menispermacea**
- b. Not this combination 4
- 4a. Hypanthium up to 8 mm, usually shorter than or equal to, rarely slightly longer than the calyx 5
- b. Hypanthium (8–)10–25 mm, longer than the calyx 8
- 5a. Leaves always entire, up to 20 cm long, suborbicular to broadly ovate, apex often caudate, 5–30 mm long, 7–9-nerved **66. B. pyrrhoneura**
- b. Leaves otherwise, varying in shape and size 6
- 6a. Hypanthium thick, infundibuliform, 3–4 by 2–2.5 mm, flowers yellow-orange turning red, filament hairy **60. B. kingii**
- b. Hypanthium thin, tubular or turbinate, flowers greenish, yellowish or pinkish, filament glabrous 7
- 7a. Buds fusiform, hypanthium turbinate, c. 2 mm, ovary densely sericeous **59. B. havilandii**
- b. Buds globose, hypanthium tubular, 2–4 mm, ovary glabrous or hairy along sutures, rarely woolly all over **67. B. wrayi**
- 8a. Buds large, c. 15 mm long **58. B. franckii**
- b. Buds much smaller 9
- 9a. Leaves suborbicular, bifid 1/3, nerves 9–11, often greyish pubescent along the margin **54. B. decumbens**
- b. Leaves not as above, nerves 3–7 10
- 10a. Tendrils, twigs and leaf undersides cupreous tomentose **53. B. cuprea**
- b. Indumentum of leaves not cupreous or silky **50. B. bidentata**
- 11a. Inflorescence a narrowly elongate raceme, 10–20 cm long 12
- b. Inflorescences corymbose or subcorymbose 13
- 12a. Leaves chartaceous; buds smooth, flowers yellow turning red **63. B. lucida**
- b. Leaves coriaceous; buds ribbed, flowers greenish-white or yellow **55. B. elmeri**
- 13a. Calyx campanulate, splitting regularly 1/2–1/3 into 5 erect, triangular lobes **52. B. campanulata**
- b. Calyx not campanulate, splitting irregularly into 2–4 patent or reflexed segments 14
- 14a. Nerves (3–)5(–7); hypanthium usually short, tubular or infundibuliform, 5–9 mm 15
- b. Nerves 3(–5); hypanthium tubular, usually 10 mm or more 16
- 15a. Buds spherical, strongly 10-ribbed, c. 8 mm diam., ovary and style glabrous **65. B. posthumi**
- b. Stipe and ovary hairy at least along sutures **56. B. finlaysonian**
- 16a. Leaves coriaceous, glabrous, lanceolate or ovate-oblong, often with revolute margin **62. B. lambiana**
- b. Leaves mostly chartaceous, rarely coriaceous, glabrous to densely hairy below 17

- 17a. Main nerves connected by several prominent perpendicular cross veins; bracts ovate lanceolate, 10–15 by 5–7 mm **51. *B. burbidgei***
 b. Not this combination of characters **61. *B. kockiana***

50. *Bauhinia bidentata* Jack

Bauhinia bidentata Jack, Mal. Misc. 2 (1822) 76; Baker in Hook. f., Fl. Brit. India 2 (1878) 279; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 311; Larsen & Larsen in Fl. Thailand 4 (1984) 23; Nord. J. Bot. 13 (1993) 662. — *Phanera bidentata* (Jack) Benth. in Miq., Pl. Jungh. (1852) 263, p.p. (excl. Philipp. specimens); Miq., Fl. Ind. Bat. 1, 1 (1855) 64; de Wit, Reinwardtia 3 (1956) 495. — Type: *Jack s.n.*, 1819 (E lecto), Penang I.

Bauhinia cornifolia Baker in Hook. f., Fl. Brit. India 2 (1878) 278. — Type: *Griffith 1878* (K), Penang Island.

Bauhinia scortechinii Prain, J. As. Soc. Beng. 66, ii (1897) 188. — Type: *Scortechini 698* (K lecto), Perak. See note.

Bauhinia monticola Ridley, J. As. Soc. Str. Br. 75 (1917) 28. — Type: *Robinson s.n.* (SING holo; K), Selangor.

Bauhinia breviflora Ridley, Fl. Malay Penins. 5 (1925) 306. — Type: *Burkill & Haniff SF 16867* (K holo; SING), Pahang.

Bauhinia gracilipes Merr., Pap. Mich. Acad. Sc. 19 (1934) 157. — Type: *Bartlett 7600* (A holo; C, L, W), Sumatra.

Large, tendrilled *climber*; young branches tomentose, later glabrous. *Leaves* entire or emarginate; stipules broadly falcate to auriculate, c. 5 mm long, early caducous; petioles slender, 1–5 mm; lamina with more or less cordate to truncate base; apex acute, emarginate or very shallowly bifid (1/4 at most); nerves 4–7; much varying in size, up to 14.5 by 12 cm; upper surface usually glabrous or nearly so; lower hairy in varying degree. *Inflorescence* corymbose, often elongating during anthesis, up to 10 cm, axis and other floral parts including the buds more or less hairy; pedicels slender; bracts ovate-triangular to linear-lanceolate, 2–10 mm, early caducous; bracteoles smaller, 1–6 mm. *Buds* ovoid apiculate. *Hypanthium* tubular, striate, 5–25 mm (at anthesis). *Calyx* splitting into 3 (or 4) reflexed lobes. *Petals* yellow turning red, unequal, obovate, shortly but distinctly clawed, 15–22 mm long. *Stamens* 3 fertile; filaments glabrous or hairy, 2–9 mm long, usually enlarged at base; anthers 2–3 mm; staminodes 2–7, usually much smaller than the stamens, sometimes with diminutive anthers. *Ovary* 3–5 mm, on a c. 3 mm long stipe, hairy all over or along the suture only; style c. 3 mm; the stigma capitate to small peltate. *Pods* oblong, up to 10 cm long, glabrous. *Seeds* up to 5, flat, c. 1 cm across.

Distribution — *Malesia*: Sumatra, Malay Peninsula.

Habitat — A variable species found from the lowland rain forest to the mountain forests at 1500 m altitude, along streams and forest margins.

Note — *Bauhinia scortechinii* Prain is only known from the type specimen from Perak, G. Haram. A specimen in K, consisting of two short flowering branches with closed buds, has been studied. This specimen, together with Prain's description, clearly indicates that it belongs to *B. bidentata*. However, it has not been possible to place it with certainty under any of the varieties as mentioned below.

KEY TO THE VARIETIES

- 1a. Filaments of fertile stamens hairy 2
- b. Filaments of fertile stamens glabrous, rarely glabrescent 6
- 2a. Hypanthium 10–20 mm; bracts 2–3 mm, bracteoles 1–2 mm; flower buds glabrous to densely hairy 3
- b. Hypanthium 5–10 mm, flower buds densely hairy 5
- 3a. Flower buds glabrous or glabrescent; ovary hairy along sutures, stipe hairy **b. var. breviflora**
- b. Flower buds hairy; ovary hairy all over or laterally glabrous, stipe hairy 4
- 4a. Hypanthium slender, 10–20 mm, buds rusty pubescent, ovary hairy all over, leaves ovate-orbicular, 7–9-nerved, apex entire to 1/5 bifid **a. var. bidentata**
- b. Hypanthium thick, 10–12 mm, buds coppery silky hairy, ovary laterally glabrous, leaves broadly ovate, 5–7-nerved, apex entire to 1/3 bifid ... **f. var. monticola**
- 5a. Leaves entire, (broadly) ovate, apex acute to acuminate, buds ferruginous hairy, often with 2 ridges on each sepal **d. var. fraseri**
- b. Leaves broadly ovate, emarginate to 1/3 bifid, rarely entire, buds coppery silky hairy **f. var. monticola**
- 6a. Bracts narrow lanceolate, 3–4 mm, bracteoles filiform, 1–2 mm, leaves ovate ... **c. var. cornifolia**
- b. Bracts ovate-elliptic, 4–5 by 2 mm, bracteoles lanceolate, 1–2 mm, leaves ovate-orbicular **e. var. gracilipes**

a. var. bidentata

Phanera bidentata (Jack) Benth. subsp. *bidentata* var. *bidentata*

Leaves ovate-orbicular, usually shallowly bifid to 1/5 bifid, 7–9-nerved. *Flower buds* hairy. *Petals* distinctly short-clawed, claw 1–2 mm. *Hypanthium* 10–20 mm. *Ovary* and stipe hairy all over, hairs often appressed. *Stamens* with the filaments hairy and with less swollen base than var. *gracilipes*, often subulate, 3–5 mm.

Distribution — *Malesia*: Malay Peninsula (Penang I., where it seems to be common, and one collection from Perak). There is a collection from the Nicobar Islands in C.

Habitat — Mainly a lowland species.

Notes — 1. The type of *Bauhinia bidentata* is Jack's plant represented by a specimen in E, a part of the protologue is found in Jack's handwriting on this sheath. De Wit (l.c.: 497), evidently not aware of this, designated a neotype in C, collected in 1822 by Wallich (s.n.) in Penang. As Jack's specimen has been found this has to be accepted as the lectotype or even holotype.

2. For discussion of *Phanera bicornuta* Miq., see under *Bauhinia integrifolia*, p. 481.

b. var. breviflora (Ridley) K. & S.S. Larsen

Bauhinia bidentata Jack var. *breviflora* (Ridley) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Bauhinia breviflora* Ridley. — *Bauhinia bidentata* Jack sensu Prain, J. As. Soc. Beng. 66, ii (1897) 187 (excl. type).

Close to var. *bidentata* but deviating in the following characters: *Leaf* lamina from sub-orbicular to broadly ovate; apex usually emarginate, rarely (sub)acute. *Flower buds* glabrous or glabrescent. *Petals* with indistinct claw. *Ovary* shaggy-hairy along suture only.

Distribution — *Malesia*: all over the Malay Peninsula.

Habitat — Mainly a lowland plant.

Notes — 1. Prain (l.c.) recognized two closely related species, *Bauhinia bidentata* and *B. cornifolia*; in the former the ovary is described as sparsely pubescent, in the latter as densely rusty downy; however, some of the specimens he quoted under *cornifolia* have an ovary apparently similar to the type of *bidentata*; some of the specimens he quoted under *bidentata* have a sparsely pubescent ovary except Wallich 5778 from Penang, which has the ovary densely hairy as the type of *B. bidentata*. We have, therefore, reestablished var. *breviflora* to accommodate part of his *B. bidentata*.

2. De Wit [Reinwardtia 3 (1956) 495] uses the length of the filaments of the fertile stamens to separate his taxa; we found that this character is not reliable as in the same flower the filaments may have different lengths.

3. Some collections from Selangor, e.g. J. C. 1583, have unusually larger leaves, up to 12–14.5 cm, and also larger inflorescences and flowers; the filaments, however, are hairy. Possibly these collections represent a local ecotype.

c. var. *cornifolia* (Baker) Bennett

Bauhinia bidentata Jack var. *cornifolia* (Baker) Bennett, Ind. J. For. 5 (1982) 326; Larsen & Larsen, Nord. J. Bot. 13 (1993) 663. — *Bauhinia cornifolia* Baker.

Deviates from var. *bidentata* by having entire leaves, the filaments thick towards the base, glabrous, rarely glabrescent. From var. *gracilipes* it deviates by the ovate leaves, the bracts being narrow lanceolate, 3–4 mm, and the bracteoles filiform, 1–2 mm.

Distribution — *Malesia*: Malay Peninsula.

Habitat — Mainly in lowland forest.

d. var. *fraseri* (de Wit) K. & S.S. Larsen

Bauhinia bidentata Jack var. *fraseri* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Phanera bidentata* (Jack) Benth. subsp. *bidentata* var. *fraseri* de Wit, Reinwardtia 3 (1956) 497. — Type: *Comer SF 33198* (SING holo; K), Pahang.

Leaves entire, ovate-elliptic with truncate to cordate base, apex acute to acuminate, rather small, mostly 4–6 cm long, 3.5–5 cm broad, rarely longer; leaf undersides ferrugineous pubescent. Bracts and bracteoles longer than in the other varieties, 7–10 mm and 3–5 mm respectively; pedicels shorter, giving the whole *inflorescence* a more condensed look. *Hypanthium* 5–10 mm. The indumentum of the *floral parts* is densely ferrugineous and the buds usually with two ribs on each sepal; on the young bud this character is, however, not always as clear as it seems from de Wit's description.

Distribution — *Malesia*: Malay Peninsula (Cameron Highlands, Mt Mengkuang and Perak, Mt Kebau, Fraser's Hill, and probably other high mountains in the area).

Habitat — Mountain species, found usually above 1000 m.

e. var. gracilipes (Merr.) K. & S.S. Larsen

Bauhinia bidentata Jack var. *gracilipes* (Merr.) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Bauhinia gracilipes* Merr.

Leaves vary from small to large, broadly to narrowly ovate with obtuse, truncate or cordate base, up to 10 by 7 cm. The *inflorescence* is open, ferrugineous; bracts ovate-elliptic; pedicels 20–23 mm. *Hypanthium* 17–25 mm. Most characteristic are the filaments being glabrous with a swollen base.

Distribution — *Malesia*: N Sumatra.

Habitat — Mainly restricted to the lowlands.

f. var. monticola (Ridley) K. & S.S. Larsen

Bauhinia bidentata Jack var. *monticola* (Ridley) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Bauhinia monticola* Ridley.

This variety is close to var. *fraseri* but the *leaves* are broader, the apex entire to bifid to 1/3, with the tip of the lobes acute to acuminate, slightly falcate, leaf underside copery puberulous. *Buds* smooth. *Hypanthium* thicker than in var. *fraseri*, and filaments much longer.

Distribution — *Malesia*: Malay Peninsula.

Habitat — Mountain forest about 1500 m altitude.

51. Bauhinia burbridgei Stapf

Bauhinia burbridgei Stapf, Trans. Linn. Soc. London (Bot.) 2 (1894) 143. — *Phanera kockiana* (Korth.) Benth. var. *burbridgei* (Stapf) de Wit, Reinwardtia 3 (1956) 523. — Type: *Beccari* 633 (FI holo).

Tendrilled *liana* up to 30 m; young shoots densely reddish brown tomentose, later glabrous, greyish brown. *Leaves*: stipules early caducous (not seen); petiole short, stout, 3–7 mm, reddish brown tomentose; lamina oblong to elliptic oblong, 8–18 by 4–6.5 cm, base obtuse to cuneate, apex acuminate with a c. 1 cm long acumen; upper surface glabrous, lower sparsely hairy, particularly on the nerves; nerves 3, prominent, distinctly impressed on upper surface, on the lower connected by several prominent perpendicular cross veins. *Inflorescences* lateral and terminal reddish brown corymbs, up to 11 cm long; pedicels 3–4.5 cm; bracts ovate oblong, acute, 10–15 by 5–7 mm; bracteoles narrowly lanceolate, 6–10 by 1–2 mm, inserted about the middle of the pedicel. *Buds* globose, pubescent, 5–6 mm. *Hypanthium* narrowly tubular, 12–15 mm, tomentose, striate. *Calyx* splitting into 2–4 reflexed lobes. *Petals* orange to red, short-clawed, subequal, obovate, 16–24 by 8–20 mm. *Stamens* 3 fertile; filaments glabrous, 7–11 mm; anthers 1.5 mm diam.; staminodes 3–5, 3–7 mm long. *Ovary* c. 5 mm, shortly stipitate, reddish brown hirsute, laterally glabrescent; style c. 5 mm, glabrous at least in upper part; stigma capitate. *Pods* strap-shaped, thinly woody-valved, c. 11 by 3 cm. *Seeds* unknown.

Distribution — *Malesia*: Borneo (Sarawak, Brunei, Sabah).

Habitat — Hillside evergreen forests.

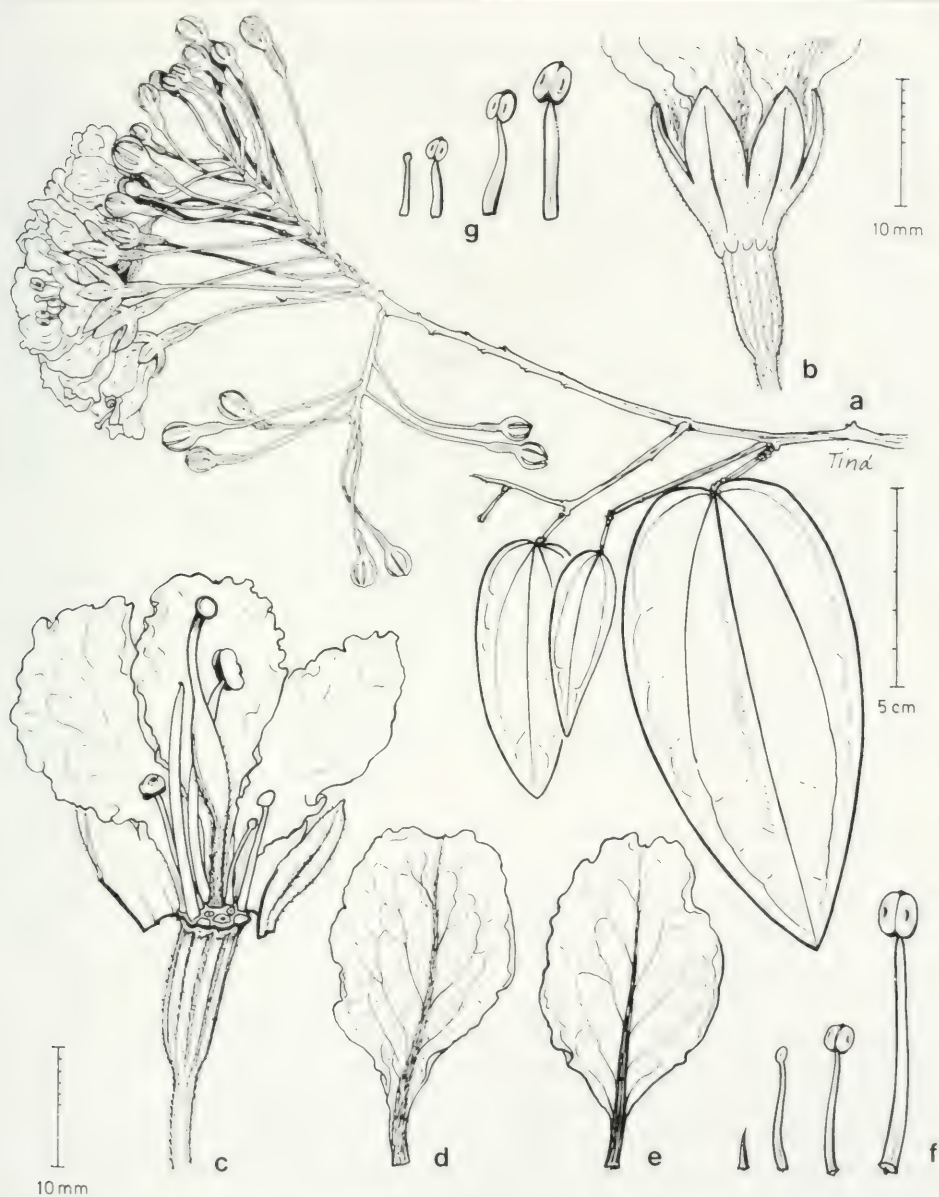


Fig. 14. *Bauhinia campanulata* S.S. Larsen. a. Flowering twig; b. base of flower; c. flower, opened; d, e. petals; f, g. stamens (Simpson & Marsh 2501). Drawing K. Tind. Reproduced from Nord. J. Bot. 14.

52. *Bauhinia campanulata* S.S. Larsen

Bauhinia campanulata S.S. Larsen, Nord. J. Bot. 14 (1994) 289. — Type: Simpson & Marsh 2501 (K holotype: AAU, BRUN), Brunei.

Climber (tendrils not seen). *Leaves*: stipules not seen; petioles glabrous, 1–2 cm, thickened at both ends; lamina coriaceous, entire, ovate-lanceolate to lanceolate, 5.5–11

by 1.8–6.2 cm, apex subacute, base truncate to shallowly cordate; glabrous on both surfaces; nerves 3 long ones and 2 short basal ones. *Inflorescences* corymbose; axis finely reddish pubescent, 1–5 cm; pedicels 4.5–5.5 cm, finely reddish puberulous; bracts not seen; bracteoles subulate, c. 2 mm, hairy along the margin, subopposite, inserted at 1–2 cm above the base. *Buds* obovoid, finely reddish puberulous, 10 by 8 mm. *Hypanthium* tubular, striate, hairy as the buds, 8–10 mm long, gradually tapering towards the pedicel. *Calyx* campanulate, c. 13 mm, splitting regularly 1/2 to 2/3 into 5 erect, triangular lobes. *Petals* yellowish, turning orange, later red, subequal, obovate to oblong, 24–27 by 12–16 mm, including the c. 3 mm long claw, margin undulate; inner surface glabrous, outer sparsely pubescent, glabrous towards the margin. *Stamens* and staminodes 10: 3 large stamens with filaments 18–20 mm and ellipsoid anthers, 3 by 2 mm; 3 small stamens with filaments 8–10 mm and globose anthers, 1.5 mm; 4 staminodes, 2–9 mm; anthers opening by a central pore, connective produced into a minute apical tip. *Ovary* 9 mm, slightly hairy along the suture; stipe 6 mm, hairy; style 6 mm, glabrous, curved; stigma capitate; ovules 8. *Pods* unknown. — **Fig. 14.**

Distribution — *Malesia*: Brunei, endemic.

Habitat — Hill dipterocarp forest, c. 350 m altitude.

53. *Bauhinia cuprea* Ridley

Bauhinia cuprea Ridley, J. Str. Br. Roy. As. Soc. 61 (1912) 2; Fl. Malay Penins. 1 (1922) 630. — *Phanera cuprea* (Ridley) de Wit, Reinwardtia 3 (1956) 503. — Type: Ridley 9670 (SING neo), see note.

Tendrilled climber; tendrils and young branches coppery tomentose, later glabrescent. *Leaves*: stipules obliquely ovate, c. 5 mm, puberulous on both sides; petiole slender, glabrescent, up to 4 cm; lamina coriaceous, broadly ovate, 4–8 cm broad; apex entire or bifid, lobes deltoid, 0.5–2 cm long; base cordate; nerves 7(–9); upper surface subglabrous, lower closely appressed coppery silky. *Inflorescences* lateral and terminal, reddish puberulous corymbs or panicles; pedicels slender, up to 6 cm; bracts and bracteoles early caducous. *Buds* subglobose, pubescent, pointed. *Hypanthium* tubular, 2–2.5 cm long, striate. *Calyx* splitting into 2 or 3 reflexed lobes, c. 8 mm long. *Petals* red (or yellow turning red?), subequal, 2–2.5 cm long, elliptic ovate, with crenulate margin, coppery pubescent outside. *Stamens* 3 fertile; filaments reddish hairy, c. 3 mm; anthers c. 2 mm; staminodes usually 4. *Ovary* shortly stipitate, densely pubescent; style similarly hairy, c. 5 mm; stigma large, peltate. *Pods* unknown.

Distribution — *Malesia*: Malay Peninsula (Perak, Gunong Keladang).

Note — The only specimen mentioned in the protologue is Ridley 96901. This has not been found, neither by De Wit nor by us. De Wit indicated Ridley 9670 as 'lecto-type' but as it is not mentioned in the protologue it is correctly a neotype. We have not seen this specimen either. Two specimens collected by Ridley are in the type cover in K: one from the type locality, nr. 9669, collected in 1896, the other *s.n.*, collected in 1914. Whether these belong to *B. cuprea* has still to be studied, but they are close to *B. bidentata*.

54. *Bauhinia decumbens* Henderson

Bauhinia decumbens Henderson, Gard. Bull. Str. Settl. 7 (1933) 99. — *Phanera decumbens* (Henderson) de Wit, Reinwardtia 3 (1956) 503. — Type: *Henderson SF 22268* (K holotype; NY, SING).

Low, scrambling, tendrilled *climber*; young shoots and tendrils densely appressed reddish pubescent, later glabrous; young stems grooved, lenticellate. *Leaves*: stipules ovate to subrotundate, 3–4 mm across, reddish tomentose, up to 3.5 cm; lamina coriaceous, subrotundate, 4–6.5 cm across, bifid 1/3 with broad, triangular sinus; lobes triangular, acute; base deeply cordate; nerves 9–11; upper surface glabrous except for fine light brown pubescence on the nerves; lower densely coppery-red pubescent; margins often greyish pubescent. *Inflorescences* lateral and terminal corymbs; all parts appressed, coppery pubescent; pedicels 2–3.5 cm; bracts linear, c. 2 mm long; bracteoles minute, inserted about the middle of the pedicel or above. *Buds* globose, apiculate. *Hypanthium* narrowly tubular, 1–1.3 cm, finely striate. *Calyx* splitting into 2 or 3 more or less reflexed carinate lobes. *Petals* yellow turning red, unequal, subrotundate to broadly ovate, with undulate margin, c. 1 cm long, the median one only 6 mm, outside densely reddish silky hairy; claw short but distinct. *Stamens* 3 fertile; filaments thickened towards the base, reddish hairy, c. 5 mm, glabrous in upper part; anthers c. 2 mm across, opening by a large, oblong pore; staminodes minute, 1 or 2 (or absent). *Ovary* 3–4 mm, shortly stiped, densely coppery hairy; style 4–5 mm, hairy; stigma small, peltate. *Pods* unknown.

Distribution — *Malesia*: Malay Peninsula (Pahang, Gunong Senyem).

Habitat — The only known collection is from the open top of a limestone hill where it was found scrambling over rocks.

55. *Bauhinia elmeri* Merr.

Bauhinia elmeri Merr., Univ. Calif. Publ. Bot. 15 (1929) 102. — *Phanera elmeri* (Merr.) de Wit, Reinwardtia 3 (1956) 520. — Type: *Elmer 21786* (A lectotype; B, C, G, M, U), Sabah.

Tendrilled *liana*; young shoots rusty pubescent, later glabrous. *Leaves* entire; stipules early caducous (not seen); petioles stout, 5–10 mm, glabrescent; lamina coriaceous, ovate to elliptic, with 3 prominent nerves and two weaker ones at base, 6–12(–20) by 4–5(–8) cm; base cordate to rounded, apex acuminate to subacute; upper surface shining, lower dull, first sparsely pubescent, soon glabrous. *Inflorescences* panicles composed of densely flowered, narrow, rusty pubescent racemes, 10–15 cm long; axis warty; pedicels stout, 15–20(–25) mm; bracts ovate, tiny, pubescent; bracteoles subulate, minute. *Buds* ovoid, apiculate, strongly ribbed, c. 4 mm. *Hypanthium* tubular, ribbed, 5–8 mm. *Calyx* splitting into 2 broadly ovate, boat-shaped lobes. *Petals* greenish white or yellow, rusty hairy outside, glabrous inside, claw distinct, c. 2 mm, blade roundish with crenulate-undulate margin, 10–15 mm diam. *Stamens* 3 fertile; filaments glabrous; anthers ellipsoid; staminodes about 7 of varying length. *Ovary* c. 5 mm, hairy along suture in lower part; stipe c. 3 mm long, rusty pubescent; style short, glabrous, curved; stigma peltate. *Pods* oblong, c. 12 by 3.5 cm, smooth, glabrous. *Seeds* 3–5, ovate, c. 10 by 16 mm.

Distribution — *Malesia*: Borneo (Sarawak, Sabah, Kalimantan).

Habitat — Found on sandstone on the peak of Balikpapan in Kalimantan at c. 650 m altitude (n.v.).

56. *Bauhinia finlaysoniana* (Benth.) Baker

Bauhinia finlaysoniana (Grah. ex Benth.) Baker in Hook. f., Fl. Brit. India 2 (1878) 278; Prain, J. As. Soc. Beng. 66, ii (1897) 190; Ridley, Fl. Malay Penins. 1 (1922) 632; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 22; K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Phanera finlaysoniana* Grah. ex Benth. in Miq., Pl. Jungh. (1852) 262; Miq., Fl. Ind. Bat. 1, 1 (1855) 62; de Wit, Reinwardtia 3 (1956) 505. — Type: *Wallich Cat.* 5801 (K holo), Malay Peninsula.

Bauhinia leptopus Perkins, Fragm. Fl. Philipp. 1 (1904) 10; Merr., Philipp. J. Sc., Bot. 5 (1910) 44; Enum. Philipp. Flow. Pl. 2 (1923) 259. — *Phanera finlaysoniana* Grah. ex Benth. var. *leptopus* (Perkins) de Wit, Reinwardtia 3 (1956) 509. — Type: *Warburg 12824* (E lecto), Luzon.

Bauhinia copelandii Merr., Philipp. J. Sc., Bot. 3 (1908) 230. — Type: *Copeland 1429* (A holo; K), Mindanao.

Bauhinia ternatensis Gagnep. in Lecomte, Not. Syst. 2 (1912) 180. — Type: *Le Guillou s.n.* (P), Ternate.

Bauhinia hosei Merr., Philipp. J. Sc., Bot. 11 (1916) 80. — Type: *Hose 254* (A holo; E, L, P), Sarawak.

Bauhinia leptopus Perkins f. *javanica* Backer, Bekn. Fl. Java Nooduitg. 5, Fam. 118 (1941) 23; Blumea 5 (1945) 509. — *Phanera finlaysoniana* Grah. ex Benth. var. *javanica* (Backer) de Wit, Reinwardtia 3 (1956) 508. — Type: *Backer 17253* (BO holo).

Phanera finlaysoniana Grah. ex Benth. var. *amoena* de Wit, Reinwardtia 3 (1956) 505. — Type: *Hallier 550* (BO holo; L), Kalimantan.

Phanera finlaysoniana Grah. ex Benth. var. *montana* de Wit, Reinwardtia 3 (1956) 510. — Type: *Posthumus 2542* (BO), cult. in Bot. Gard. Bogor.

Large tendrilled *climber*; young branches pubescent in varying degree from densely covered with ferrugineous hairs to almost glabrous. *Leaves* very variable; stipules small, obovate, early caducous (not seen in all varieties); petiole 0.5–3 cm, rather slender; lamina entire, broadly ovate to ovate-oblong, up to 13 by 8 cm, usually 5-nerved, rarely 3- or 7-nerved, the 2 outer nerves shorter and fainter; apex acute to acuminate, sometimes with slightly emarginate tip; base truncate to cordate; upper surface glabrous, the lower sparsely pubescent to glabrous. *Inflorescences* terminal and lateral corymbs or panicles, axis usually pubescent; pedicels of various length, from coarse to almost filiform; bracts mostly small, narrow lanceolate, caducous; bracteoles minute, inserted below the middle of the pedicel; pedicel varying in length, up to 6.5 cm. *Buds* globose to ovoid, 3–7 mm, apiculate, pubescent. *Hypanthium* various (see the varieties) but usually shorter than or as long as the sepals or slightly longer, striate. *Calyx* splitting into 2–4 patent or reflexed lobes, inside glabrous except at the very base, often with simple or more rarely with glandular hairs. *Petals* white, yellow, or in some varieties orange to red, subequal; blade suborbicular to obovate, with crenulate margin, 10–25 mm long; claw short, distinct, 2–4 mm. *Stamens* 3 fertile; filaments filiform, glabrous or nearly so, 7–12 mm, anthers small, broadly ellipsoid; staminodes 7–11, sometimes with diminutive anthers. *Ovary* 4–6 mm, pubescent at base and along the suture, often glabrous towards the style; stipe 1–3 mm; style 2–4 mm, usually curved; stigma small, peltate or capitate. *Pods* linear oblong, glabrous, up to c. 15 by 3 cm. *Seeds* few, 4–6; only few specimens with fruit seen, mature pods only known from literature.

Distribution — Very widespread, occurring all over *Malesia* but not found in peninsular Thailand.

Habitat — Mostly a lowland species found along rivers and in clearings; but also, particularly var. *montana* and var. *amoena*, in the mountains up to 1400 m altitude.

Notes — 1. This is a very polymorphous species particularly in the eastern part of its distribution. We have suggested a division in varieties below, partly following de Wit.

2. The delimitation towards *Bauhinia kockiana* in some cases is uncertain; we suspect that hybrids may occur. In most cases, however, the two species are distinct, and in the Philippines, where *B. finlaysoniana* is particularly variable, *B. kockiana* does not occur (see page 522).

KEY TO THE VARIETIES

- 1a. Hypanthium thick, 2–3 mm broad, prominently striate, often dilated at base; indumentum ferrugineous; staminodes curved towards ovary . . . **a. var. finlaysoniana**
- b. Hypanthium narrow, ± striate; staminodes not curved as above 2
- 2a. Indumentum greyish to light brown; flowers small, petals white to cream, pedicels 15–25 mm **d. var. montana**
- b. Indumentum brown to reddish brown; flowers yellow-orange to red; pedicels up to 65 mm 3
- 3a. Leaves at inflorescence cordate; petals red to scarlet, 2–3 cm long; filaments 10–15 mm **b. var. amoena**
- b. Not this combination **c. var. leptopus**

a. var. finlaysoniana

Bauhinia leptopus Perkins f. *javanica* Backer — *Phanera finlaysoniana* Grah. ex Benth. var. *javanica* (Backer) de Wit.

The typical variety has ovate to ovate-oblong, 5-nerved leaves. *Inflorescences* rusty pubescent, partial inflorescences narrow racemes; pedicels 1.5–3 cm. *Hypanthium* coarse, striate, tubular, usually somewhat dilated at base, 4–7 by 2–3 mm. *Flowers* creamy to yellowish. *Petals* suborbicular, c. 15 mm, distinctly and abruptly narrowed towards the c. 4 mm long claw. *Filaments* 7–10 mm, thicker towards the base; the bundle of staminodes usually curving towards the ovary.

Distribution — *Malesia*: Malay Peninsula, Java.

Habitat — Evergreen forests, up to 600 m altitude.

Note — All material we have seen has notes indicating the colour of the petals as yellowish white; De Wit (l.c.: 509) quotes a note by Backer (not seen by us) in which he describes the flower as yellow turning red.

b. var. amoena (de Wit) K. & S.S. Larsen

Bauhinia finlaysoniana (Grah. ex Benth.) Baker var. *amoena* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Phanera finlaysoniana* var. *amoena* de Wit — *Bauhinia hosei* Merr. (see note).

The indumentum of this variety is reddish brown. *Leaves* large, broadly ovate, with 5–7 nerves, 8–11 by 6–8.5 cm, those in the inflorescence smaller, \pm cordate and often only 3-nerved. *Inflorescences* corymbose. *Hypanthium* narrowly tubular or infundibuliform, \pm striate, up to 10 mm. *Flowers* bright red to scarlet. *Petals* obovate, 2–3 cm including the short claw. *Filaments* slender, 10–15 mm long.

Distribution — *Malesia*: Borneo.

Habitat — A mountain plant which on Mt Kinabalu reaches 1300 m altitude and on Mt Penrissen (S of Kuching) 1400 m. On the latter locality it grows on sandstone.

Note — *Bauhinia hosei* Merr. is intermediate between var. *amoena* and var. *leptopus*. We have tentatively placed it under synonymy here.

c. var. **leptopus** (Perkins) K. & S.S. Larsen

Bauhinia finlaysoniana (Grah. ex Benth.) Baker var. *leptopus* (Perkins) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Phanera finlaysoniana* Grah. ex Benth. var. *leptopus* (Perkins) de Wit — *Bauhinia leptopus* Perkins — *Bauhinia copelandii* Merr.

In this variety the shape of the leaves is close to var. *finlaysoniana*. The indumentum is brown to reddish brown. *Inflorescences* corymbose; pedicels rather slender, 25–65 mm long. *Hypanthium* narrow, \pm striate, often parallel-sided, 7–10 mm long. *Flowers* yellowish to orange-red. *Petals* suborbicular to obovate.

Distribution — *Malesia*: from Sumatra and Borneo to the Moluccas and the Philippines.

Habitat — In forest from the lowlands up to 350 m altitude.

d. var. **montana** (de Wit) K. & S.S. Larsen

Bauhinia finlaysoniana (Grah. ex Benth.) Baker var. *montana* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 663. — *Phanera finlaysoniana* Grah. ex Benth. var. *montana* de Wit — *Bauhinia ternatensis* Gagnep.

This variety is close to var. *leptopus*, but has rather large *leaves*, cordate to ovate, up to 13 by 8 cm, with 5–7 nerves. The indumentum is greyish to light brown. *Inflorescences* smaller. *Flowers* small, white or cream-coloured, on short, slender pedicels, 15–25 mm. *Hypanthium* narrow, faintly striate. *Petals* narrowly obovate with the blade tapering towards the short claw.

Distribution — *Malesia*: Celebes, Moluccas (Ambon, Bacan, Buru, Ceram, Obi).

Habitat — It seems to be found at a higher altitude than var. *leptopus* and var. *finlaysoniana*: (100–)500–1000 m.

57. **Bauhinia foraminifer** Gagnep.

Bauhinia foraminifer Gagnep. in Lec., Not. Syst. 2 (1912) 171; Merr., Bibl. Enum. Born. Pl. (1921) 298; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 22. — *Phanera foraminifer* (Gagnep.) de Wit, Reinwardtia 3 (1956) 491 ('*foraminifera*'). — Type: Beccari 2365 (P holo, K), Sarawak.

KEY TO THE VARIETIES

- a. Leaflets ovate to ovate-oblong, 2.5–6.5 by 1.5–2.5 cm, tips obtuse to subacute . . . a. var. **foraminifer**
b. Leaflets \pm falcate, larger, 4–10 by 2–3 cm, tips acute to acuminate b. var. **falcata**

a. var. **foraminifer**

Low, scrambling, tendrilled *climber*; young shoots slender, glabrous with short tendrils. *Leaves* consisting of two free or almost free leaflets; stipules ovate, acute, c. 1.5 mm; petioles glabrescent, very slender to filiform, 1.5–3 cm, continuing in a short mucro; leaflets ovate-oblong, asymmetrical, tips rounded to subacute, usually 3-nerved, 2.5–6.5 by 1.5–2.5 cm, glabrous on upper surface, lower often glaucous, sparsely brownish to reddish pubescent, more dense on the nerves. *Inflorescences* lateral and terminal corymbs with a 2–6 cm long, glabrous axis; pedicels glabrous, filiform, 3–5 cm long; bracts triangular, 1.3 mm; bracteoles smaller, inserted about the middle of the pedicel. *Buds* globose, apiculate, glabrous, 4–5 mm. *Hypanthium* narrow tubular, striate.

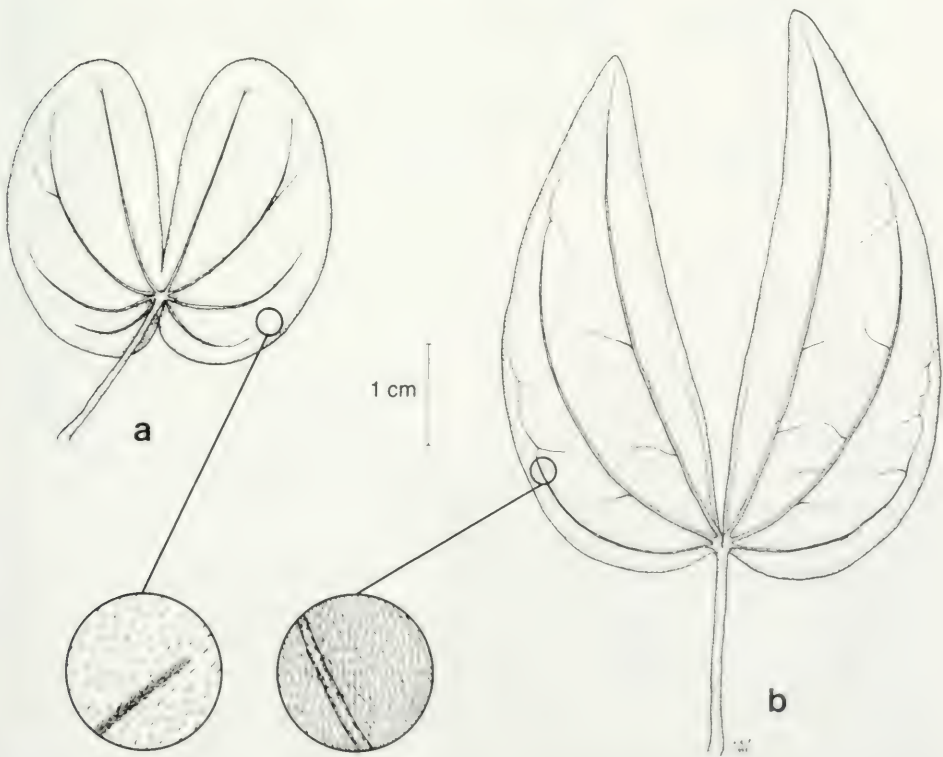


Fig. 15. *Bauhinia foraminifer* Gagnep. var. *foraminifer*, a. Leaf and detail lower surface (*Purseglove* 5010). — *Bauhinia foraminifer* Gagnep. var. *falcata* K. & S.S. Larsen, b. Leaf and detail lower surface (*Ashton BRUN* 5614). Drawing H.Æ. Pedersen.

4–7 mm. *Calyx* splitting into 2–3(–4) reflexed lobes. *Petals* white, lanceolate to ob-ovate, with undulate margin, 12–15 mm long with a distinct, 2–3 mm long claw; outside sparsely reddish hairy at the median zone. *Stamens* 3 fertile; filaments glabrous, 5–7 mm; anthers broader than long, 1.5 mm; staminodes 4–7, filiform, varying in length, shorter than or as long as the fertile stamens. *Ovary* glabrous, c. 3 mm; stipe short, 1–2 mm, with a few hairs at base; style glabrous, as long as ovary; stigma small, peltate. *Pods* unknown. — **Fig. 15a.**

Distribution — *Malesia*: Borneo (Sarawak, only found near Kuching).

Habitat — Notes are few but in the Baku National Park it reaches 100 m altitude. It has also been collected in heath forest, kerangas, on sandy soil.

Note — This variety has repeatedly been collected from the Kuching area where it is evidently not rare. In one collection the leaflets are joined in their lower third.

b. var. *falcata* K. & S.S. Larsen

Bauhinia foraminifer Gagnep. var. *falcata* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 661. — Type: Ashton 5614 (L holo; K), Brunei.

Deviates by its larger leaflets which are more or less falcate with acute to acuminate tips, and by the densely silky reddish brown indumentum on the lower side of the young leaflets. — **Fig. 15b.**

Distribution — *Malesia*: Borneo (Brunei).

Habitat — The type was collected at 275 m altitude, in 'extreme heath forest (kerangas)' on sandstone ridge. So far only known from the type locality.

58. *Bauhinia franckii* K. & S.S. Larsen

Bauhinia franckii K. & S.S. Larsen, Nord. J. Bot. 11 (1991) 633. — Type: *Franck 1406* (C holo).

Large climber; young branches furrowed, appressed ferrugineous pubescent as all young parts, inclusive the inflorescences. *Leaves*: stipules obovate, c. 1 cm long, early caducous; petioles 5–7 cm; lamina suborbicular, up to 11.5 cm across, often broader than long; base shallowly cordate, apex emarginate; nerves 9; upper surface glabrous, lower finely ferrugineous pubescent. *Inflorescences* large and broad, 10–12-flowered corymbs; bracts early caducous (not observed); bracteoles narrow lanceolate, c. 5 mm long, inserted below the middle of the pedicel; pedicel striate, 5–6 cm. *Hypanthium* tubular, striate, 2–3 cm long, c. 2 mm wide. *Buds* furrowed, ovate apiculate, 15 by 5–7 mm. *Calyx* splitting into 3 patent lobes. *Petals* pale red, subequal, 4–4.5 cm long including the claw, 2–2.5 cm broad, glabrous on ventral side, finely pubescent on the dorsal towards the claw. *Stamens* 3 fertile; filaments c. 4 mm, hairy, enlarged towards the base; anthers globose-ellipsoid, hairy, c. 2 mm; staminodes absent or minute (not observed). *Ovary* hairy throughout to the stigma; stipe short; ovary 5–7 mm; style 12–15 mm; stigma large, capitate. *Pods* unknown. — **Fig. 16.**

Distribution — *Malesia*: Malay Peninsula (endemic to Fraser's Hill, Pahang).

Note — De Wit, *Reinwardtia* 3 (1956) 498, refers to the original collection of Franck under *Bauhinia bidentata*, where he suggests that this remarkable plant may be a 'gigas' form of his var. *fraseri*. A new collection of Stone from the same area shows that the population is still existing and taxonomically different from *B. bidentata*.



Fig. 16. *Bauhinia franckii* K. & S.S. Larsen. a. Tendril; b. twig end with stipules; c. leaf, half; d. flower bud; e. petal; f. flower; g. stamen (a–c: Stone 7419; f, g: Franck 1406). Drawing K. Tind. Reproduced from Nord. J. Bot. 11.

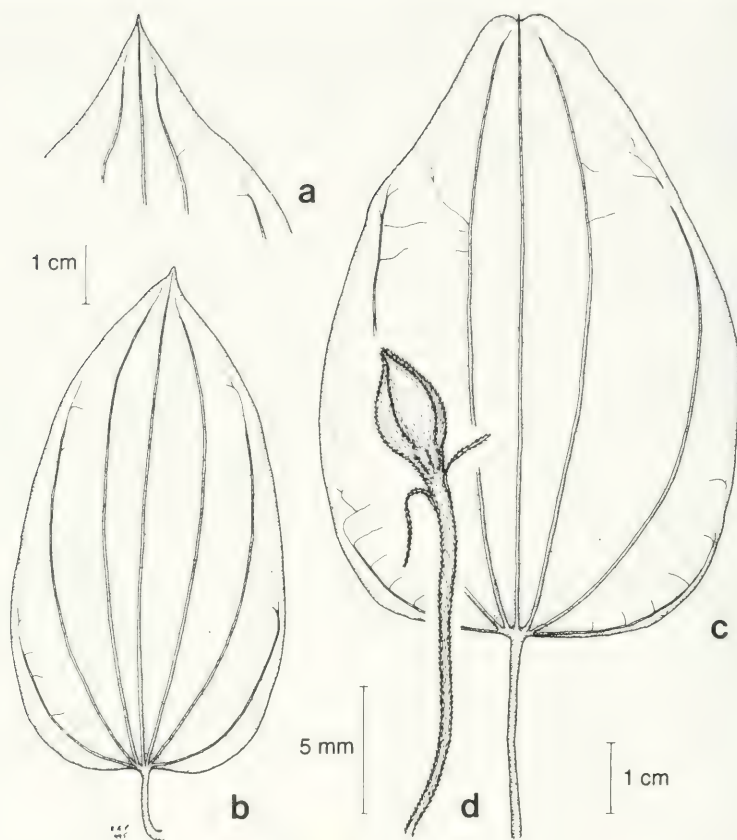


Fig. 17. *Bauhinia havilandii* Merr. a–c. Leaves, showing variation; d. flower bud (a, b: *Kostermans* 10505; c: *Forman* 813; d: *Prance* 30539). Drawing H.Æ. Pedersen.

59. *Bauhinia havilandii* Merr.

Bauhinia havilandii Merr., Philipp. J. Sc., Bot. 11 (1916) 79. — Type: *Native coll. BS 199* (US lecto).

Large, tendrilled *climber*, up to 30 m; young shoots appressed hairy, later glabrous. *Leaves* entire, glabrous on upper surface, puberulous on the nerves below; stipules early caducous (not seen); petioles pubescent, 0.5–5 cm; lamina ovate-oblong to elliptic, chartaceous, 5–12 by 3–6 cm; base obtuse to truncate, apex acute to acuminate, rarely shortly bifid or slightly emarginate with a 1–2 mm mucro; nerves 5–7, the two innermost close to and almost parallel with the midnerve. *Inflorescences* lateral and terminal, many-flowered racemes up to 5 cm long; axis and pedicels brownish appressed pubescent; pedicels filiform, 1.5–2.5 cm; bracts linear, 4–5 mm; bracteoles slightly smaller, inserted about or above the middle of the pedicel. *Buds* fusiform, 4–5 mm, greyish pubescent. *Hypanthium* turbinate, 1–2 mm. *Calyx* splitting into 2 or 3 reflexed segments, c. 5 mm. *Petals* white or greenish white, subequal, 6–8 mm long, obovate-oblong to

spathulate, with a short claw, outside light brown sericeous in median zone; margin crenulate-undulate. Fertile *stamens* 3; filaments filiform, glabrous, c. 6–8 mm; anthers broadly ellipsoid, c. 1.5–2 mm long, opening by a central, ellipsoid pore; staminodes 1 or 2, minute. *Ovary* shortly stipitate, densely light brown sericeous, 4–5 mm; style finally as long as ovary, pubescent in lower part, glabrous towards the capitate stigma. *Pods* woody valved with short velvety hairs, 20 by 6 cm. *Seeds* c. 3 (no ripe seeds seen). — **Fig. 17.**

Distribution — *Malesia*: Borneo (Sarawak, Sabah, E Kalimantan).

Habitat — In primary forests at low altitudes.

Notes — 1. In a single specimen from Sabah, *Villamil* 352, some leaves are almost orbicular, c. 10.5 cm diam.

2. The shape of the anthers deviates from other members of the section as the thecae are basically acute, furthermore the pore opening is more elongate. Perhaps for this reason De Wit, Reinwardtia 3 (1956) 486, placed *Bauhinia havilandii* as synonym under *B. glabrifolia*. We are sure that these two species are not related, and that *B. havilandii* is better placed in section *Palmatifolia*.

60. *Bauhinia kingii* Prain

Bauhinia kingii Prain, J. As. Soc. Beng. 66, ii (1897) 189. — *Phanera bidentata* Jack subsp. *bidentata* var. *kingii* (Prain) de Wit, Reinwardtia 3 (1956) 498. — Type: *Scortechini* 320 (K lecto), Perak.

Tendrilled climber; young branches terete, glabrous. *Leaves* coriaceous; stipules early caducous (not seen); petioles slender, up to 2.5 cm; lamina with deeply cordate base; apex shortly acuminate to emarginate or shallowly bifid; nerves 5–7; 4–7 by 3.5–5 cm; upper surface glabrous, lower almost glabrous except for the thinly pubescent nerves. *Inflorescences* simple, lateral or terminal, few-flowered corymbs or larger, lax panicles of rather few-flowered corymbs; peduncles glabrous; pedicels sparsely puberulous, 1.5–3 cm; bracts lanceolate, 2–4 mm; bracteoles subulate, tiny, early caducous, inserted about the middle of the pedicel. *Buds* rusty pubescent, subglobose, 8–9 mm including the campanulate to infundibuliform, striate hypanthium, 3–4 by 2–2.5 mm, shorter than sepals. *Calyx* splitting into 2 or 3 patent lobes. *Petals* orange-yellow turning red, subequal, oblanceolate, obtuse, shortly clawed, 12–15 mm long, with crenulate-undulate margin, finely rusty pubescent dorsally. *Stamens* 3 fertile, filaments thin, 7–10 mm, hirsute. *Ovary* c. 5 mm, rusty pubescent along the suture; stipe c. 1 mm; style puberulous, c. 4 mm; stigma small, peltate. *Pods* according to Prain (l.c.) glabrous, narrowly ovate, c. 7 cm long. *Seeds* 1 or 2, ovate, compressed.

Distribution — *Malesia*: Malay Peninsula (Perak, Selangor and Pahang).

Habitat — Seems to be restricted to altitudes between 1000 and 1600 m.

Notes — 1. Prain also reported this species from Borneo based on a specimen collected by Beccari; this, however, is *Bauhinia wrayi*.

2. This is a rather distinct taxon characterized by the short campanulate to infundibuliform hypanthium, the long and thin filaments, and the deeply cordate, coriaceous leaves. De Wit suggested that *Bauhinia monticola* Ridley belongs here, but this is not the case.

3. The description above is (except for the pods) based on the three specimens available to us.

61. *Bauhinia kockiana* Korth.

Bauhinia kockiana Korth., Kruidk. (1841) 87, pl. 10; Prain, J. As. Soc. Beng. 66, ii (1897) 190, 497.
— *Phanera kockiana* (Korth.) Benth. in Miq., Pl. Jungh. (1852) 262; Miq., Fl. Ind. Bat. 1, 1 (1855) 63; de Wit, Reinwardtia 3 (1956) 521. — Type: *Korthals s.n.* (L), Sumatra.
Bauhinia creaghii Baker, Kew Bull. (1896) 21. — Type: *Creagh s.n.* (K lecto), Sabah.

A very polymorphic species; see also note 2 under *Bauhinia finlaysoniana* (p. 515). We have recognized here some distinctive varieties. It must be admitted that the delimitation towards *B. finlaysoniana* is not always clear; in spite of this we have maintained the two with specific status.

KEY TO THE VARIETIES

- 1a. Filament of fertile stamens short, c. 3 mm, hairy as the staminodes **d. var. beccarii**
- b. Filament of fertile stamens longer, 6–13 mm, glabrous as the staminodes 2
- 2a. Pedicels short, 1–1.5 cm; hypanthium 2–2.7 cm long; bracts large, 8–10 by 4 mm **e. var. brevipedicellata**
- b. Not this combination 3
- 3a. Hypanthium short, 4–8 mm; leaves rigidly coriaceous, small, 3.5 by 1.3 to 9 by 3 cm, glabrous **f. var. calcicola**
- b. Hypanthium and leaves otherwise 4
- 4a. Ovary silky, light brown, appressed hairy all over, hairs retained after anthesis; the leaves lanceolate, 11.5 by 2.5 to 20 by 5 cm **b. var. angustifolia**
- b. Ovary hairy along sutures only, occasionally hairy all over but after anthesis laterally glabrous 5
- 5a. Leaves small, 4 by 2 to 8 by 3.5 cm, densely rusty hairy at nerves beneath, and on petioles and inflorescences **h. var. sericeinervia**
- b. Not this combination 6
- 6a. Petioles thick, densely hairy; lower surface of leaves of young shoots and inflorescences densely hairy 7
- b. Not this combination 8
- 7a. Leaves sub-5-nerved (= with 3 long nerves reaching apex, and 2 short, distinct, basal nerves) base \pm cordate, rarely obtuse, persistently dark brown, densely hairy beneath; pedicels slender, patently hairy **i. var. velutina**
- b. Leaves 3-nerved to sub-5-nerved, base cuneate to obtuse, reddish brown beneath or mainly on the nerves; pedicels velvety hairy to puberulous **g. var. scarlatina**
- 8a. Leaves rigidly coriaceous, large, 16 by 5 to 21 by 7.5 cm, glabrous, apex acuminate, base \pm truncate **c. var. bakoensis**
- b. Leaves chartaceous to coriaceous, varying in form, size and hairiness, base cuneate to \pm truncate **a. var. kockiana**

a. var. kockiana

Bauhinia creaghii Baker.

Large, tendrilled *liana* with flattened stems which may reach up to at least 30 m; young shoots \pm hairy, usually reddish brown tomentose, later glabrous. *Leaves* entire, glabrous or sparsely hairy when young, shining on upper surface; stipules auriculate, puberulous, 4–7 mm long, early caducous; petiole usually short, c. 5 mm, reddish brown puberulous; lamina chartaceous to coriaceous, 7–13 by 4–6 cm, narrowly ovate, elliptic to oblong, apex acuminate, often with a slightly emarginate tip, usually 3-nerved, sometimes sub-5-nerved, base obtuse. *Inflorescences* lateral and terminal corymbs or short racemes, often broader than long, varying in hairiness but in early stages and the axis usually reddish or brownish tomentose; pedicels 4–6(–7) cm; bracts ovate-oblong, c. 1 cm, caducous; bracteoles linear, few mm long, inserted below the middle. *Buds* globose, apiculate, \pm prominently longitudinally ridged, 3–5 mm diam. *Hypanthium* narrow tubular, finely striate, 11–18 mm long, 1–2 mm diam., only slightly dilated at the base. *Calyx* splitting into 2 or 3 segments, glabrous inside. *Petals* yellow to orange turning red, short-clawed, broadly obovate with crenulate, undulate or flat margin, 2–2.5 cm long; outside hairy, inside almost glabrous. Fertile *stamens* 3; filaments glabrous, up to 8 mm long; anthers small, ellipsoid, 2–3 mm; reduced stamens and staminodes 3–5. *Ovary* shortly stipitate, 5–9 mm, brownish or reddish hairy, at least along the sutures; style c. 6 mm, glabrous or nearly so; stigma capitate. *Pods* narrowly elliptic, glabrous, c. 15 cm long. *Seeds* flat, broadly ovate, c. 2 cm across.

Distribution — *Malesia*: widely distributed from the Malay Peninsula (not reaching Thailand) throughout Borneo to the Lesser Sunda Islands; not reaching the Philippines.

Habitat — From sea level up to 1200 m, in a variety of habitats.

Uses — According to De Wit, in Sabah used in religious ceremonies.

b. var. angustifolia K. & S.S. Larsen

Bauhinia kockiana Korth. var. *angustifolia* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 664. — Type: *W.L. Chew c.s.* 2968 (K holotype; L, SING), Mt Kinabalu.

Deviates from the other varieties by the leaves being lanceolate, 11.5–20 by 2.5–5 cm, and the ovary light brown silky appressed-hairy all over, the indumentum retained after anthesis.

Distribution — *Malesia*: Borneo, endemic to Sabah.

Habitat & Ecology — On ultrabasic soil.

c. var. bakoensis K. & S.S. Larsen

Bauhinia kockiana Korth. var. *bakoensis* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 664. — Type: *Ilias Paie S 17902* (L holotype; K, SAN, SING), Sarawak.

Leaves large, ovate-oblong to lanceolate, glabrous, strongly coriaceous, 16–21 by 5–7.5 cm, apex acuminate, base \pm truncate; nerves 3, sometimes with 2 short basal ones; petiole 1–2 cm.

Distribution — *Malesia*: Borneo (Sarawak, only known from Bako National Park).

Habitat — Heath forest on humid podsol soil on sandstone, from sea level up to 600 m altitude.

d. var. *beccarii* K. & S.S. Larsen

Bauhinia kockiana Korth. var. *beccarii* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 664. — Type: *Petrus & Dewol* SAN 89576 (SAN holo; AAU, MO, SING), Sabah.

Deviates from the other varieties by the filaments of the fertile stamens being short, c. 3 mm, and hairy as the staminodes.

Distribution — *Malesia*: Borneo (Sabah).

Habitat — Primary forest, 600 m altitude.

e. var. *brevipedicellata* K. & S.S. Larsen

Bauhinia kockiana Korth. var. *brevipedicellata* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 664. — Type: *Mogea* 3508 (L holo; BO), Bukit Raya.

This variety deviates from the other varieties by its short pedicel, 1–1.5 cm long, the long hypanthium, 2–2.7 cm, the large, broad bracts, 8–10 by 4 cm, and the bracteoles 4 by 1 mm.

Distribution — *Malesia*: Borneo, only known from the type collected on Bukit Raya, C Kalimantan.

Habitat — Primary forest.

f. var. *callicola* K. & S.S. Larsen

Bauhinia kockiana Korth. var. *callicola* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 664. — Type: *Martin* S 38676 (L holo; AAU, K, KEP), Sarawak.

Leaves rigidly coriaceous, narrowly elliptic, glabrous, small, 3.5–9 by 1.3–3 cm, hypanthium short, 4–8 mm.

Distribution — *Malesia*: Borneo (Sarawak, only known from Bau District).

Habitat — On limestone at low altitude.

g. var. *scarlatina* (Camm.) K. & S.S. Larsen

Bauhinia kockiana Korth. var. *scarlatina* (Backer ex Camm.) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 665. — *Bauhinia scarlatina* Backer ex Camm., Bul. Fac. Stiinte Cern. 3 (1929) 171. — *Phanera scarlatina* (Backer ex Camm.) de Wit, Reinwardtia 3 (1956) 526. — Type: *Jahe* 1181 (BO holo; L), Kalimantan, also cult. in Bot. Garden Bogor.

This variety has larger leaves, (7–)10–17 by 3–6 cm, larger on the basal shoots; 3- to sub-5-nerved, base cuneate to rounded, reddish brown hairy beneath, mainly on the nerves; pedicels velvety hairy to sparsely pubescent. Flowers rather large.

Distribution — *Malesia*: Borneo (Kalimantan).

Habitat — Forest, up to 700 m altitude.

h. var. *sericeinervia* (de Wit) K. & S.S. Larsen

Bauhinia kockiana Korth. var. *sericeinervia* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 665. — *Phanera kockiana* (Korth.) Benth. var. *sericeinervia* de Wit, Reinwardtia 3 (1956) 524. — Type: *Posthumus* 675 (BO holo; L, U), Sumatra.

Characterized by small leaves, from 4 by 2 to 8 by 3.5 cm, densely rusty hairy at nerves beneath and at petioles and inflorescences. Flowers somewhat smaller than in var. *kockiana*.

Distribution — *Malesia*: Sumatra.

Habitat — In primary forest at lower altitudes.

i. var. *velutina* (de Wit) K. & S.S. Larsen

Bauhinia kockiana Korth. var. *velutina* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 665. — *Phanera kockiana* (Korth.) Benth. var. *velutina* de Wit, Reinwardtia 3 (1956) 525. — Type: *Hallier* 2554 (BO holo; B, K, L, U), Kalimantan.

Characterized by leaves sub-5-nerved, cross-veins prominent, base \pm cordate, rarely obtuse, persistently dark brown, densely hairy beneath; the pedicels slender, patently hairy.

Distribution — *Malesia*: Borneo, from W Kalimantan to Sarawak.

Habitat — Riverine forests, altitude 150 m.

Note — Only known from few collections.

62. *Bauhinia lambiana* Baker f.

Bauhinia lambiana Baker f., J. Bot., London 76 (1938) 19. — *Phanera lambiana* (Baker f.) de Wit, Reinwardtia 3 (1956) 525. — Type: *Haviland & Hose* 2029 (BM holo).

Tendrilled liana. *Leaves* entire, glabrous; stipules early caducous (not seen); petiole thick, 15–18 mm long; lamina ovate, lanceolate or narrowly oblong, coriaceous, in dried state often with revolute margin, 15–26 by 3–6.5 cm; nerves 3–5, the lateral ones weak, transverse nerves not distinct; base cordate to truncate, apex acuminate. *Inflorescences* corymbose, finely ferrugineous puberulous; bracts early caducous (not seen); bracteoles subulate, rusty pubescent, c. 3 mm, inserted in the lower half of the pedicel; pedicel slender, c. 5 cm. *Buds* globose, apiculate, c. 6 mm, finely pubescent. *Hypanthium* narrow tubular, striate, finely pubescent, c. 15 mm long. *Calyx* splitting into 2 or 3 patent segments. *Petals* yellow, later red; blade broadly obovate to suborbicular, c. 2 cm, with a distinct, 2–3 mm long claw, sparsely pubescent on the outer side. *Stamens* 3 fertile, 10–12 mm long, early caducous; filaments glabrous; anthers broadly elliptic, c. 2 mm; staminodes 4–6, half as long as the stamens. *Ovary* c. 6 mm, shortly stipitate, glabrous, except for the stipe and the lower half of the dorsal suture; style 5 mm, slender, glabrous; stigma small, peltate. *Pods* unknown. — **Fig. 18.**

Distribution — *Malesia*: described from Mt Lambia in the northern part of Sarawak and also found in Labi Nat. Park in Brunei.

Habitat — Lowland rain forest up to 330 m.

Notes — 1. The characteristic coriaceous leaves which in herbarium specimens have revolute margins (on fully mature leaves) are very distinctive.

2. The species is closely related to *Bauhinia kockiana* and future studies in nature may lead to the decision to join it with that species as an infraspecific taxon.



Fig. 18. *Bauhinia lambiana* Baker f. a, b. Leaves, lower surface (a: Sinclair & Kadim 10502; b: Haviland & Hose s.n.). Drawing H.Æ. Pedersen.

63. *Bauhinia lucida* (Miq.) Prain

Bauhinia lucida (Miq.) Prain, J. As. Soc. Beng. 66, ii (1897) 188; Ridley, Fl. Malay Penins. 1 (1922) 630. — *Phanera lucida* [Wall. ex Benth. in Miq., Pl. Jungh. (1852) 262, nom. nud.] Miq., Fl. Ind. Bat. 1, 1 (1855) 62; de Wit, Reinwardtia 3 (1956) 511. — Type: *Wallich 5779 A* (K lecto; BR), Penang I.

Bauhinia emarginata auct. non Jack (nec Miller): Baker in Hook. f., Fl. Brit. India 2 (1878) 278.

Large, tendrilled *liana*; all young parts glabrous; young branches terete, finely striate. *Leaves*: stipules early caducous (not observed); petioles slender, 0.5–2 cm; lamina chartaceous, entire, narrowly ovate to elliptic; apex acuminate with blunt, rarely slightly emarginate tip; base cordate, 7–15 by 5–9 cm; nerves 5(–7); both surfaces glossy, glabrous, except for a few appressed hairs on the nerves on the lower side. *Inflorescences* terminal or lateral, slender racemes, 10–20 cm long, axis strongly ribbed, brownish puberulous as the rest of the inflorescence; pedicels 15–20 mm, sturdy, striate; bracts narrow lanceolate, c. 5 mm, caducous; bracteoles subulate, not opposite, 3–4 mm, inserted about the middle. *Buds* globose to ovate, apiculate, brownish silky pubescent, smooth, margins of sepals not particularly raised, 5–7 mm long. *Hypanthium* broad tubular, ribbed, gibbous at base, 5–7 mm long. *Calyx* splitting into 3 or 4 patent to reflexed lobes, inside hairy at the base. *Petals* yellow turning red, ovate-oblong, outside rusty pubescent, c. 17 mm long including the 3–4 mm claw. *Stamens* 3 fertile; filaments glabrous, slightly enlarged at base, c. 10 mm; anthers spherical, c. 1 mm; staminodes many, up to 15, up to 5 mm long, thickened at base. *Ovary* c. 5 mm, on a 2–3 mm long, reddish brown, pubescent stipe, hairy along the suture; style glabrous; stigma indistinct. *Pods* (not seen) according to Prain glabrous, narrowly oblong, c. 10 by 2.5 cm. *Seeds* 4–6, irregularly orbicular, c. 1 cm across.

Distribution — *Malesia*: Malay Peninsula (coastal zone of Penang and Perak and on Batu Togo). Also on Mentawai Isl. (Siberut) W of Sumatra.

Note — Baker (l.c.: 285) mentions *Bauhinia lucida* under 'doubtful species'; this refers to *Wallich Cat. 5779 B*, a sterile specimen with two free leaflets, a collection that cannot be identified.

64. *Bauhinia menispermacea* Gagnep.

Bauhinia menispermacea Gagnep. in Lec., Not. Syst. 2 (1912) 176. — *Phanera menispermacea* (Gagnep.) de Wit, Reinwardtia 3 (1956) 513. — Type: *Haviland & Hose 1014 P* (K lecto; P).

Slender, tendrilled *climber*; all branches glabrous. *Leaves*: stipules subglabrous, falcate, c. 5 mm, early caducous; petiole stout, glabrous, 2–5(–7) cm; lamina entire, cordate with acuminate apex, coriaceous, in dried state often with revolute margin, (5–)7-nerved; 9–15 by 6–10 cm, glabrous on both sides, lower surface often glaucescent. *Inflorescences* lateral, rather lax corymbs with 15–20 flowers; all parts glabrous; pedicels slender, almost filiform, 4–6 cm; bracts linear, c. 5 mm long, with few hairs along the margin, early caducous; bracteoles similar, smaller, inserted in lower half of pedicel. *Buds* globose, c. 5 mm diam. *Hypanthium* narrow tubular, 5–8 mm long. *Calyx* splitting into (4 or) 5 free sepals. *Petals* yellow with a dark red centre, narrowly obovate,

10–15 mm long, with crenate-undulate margin; claw very short. *Stamens* 3 fertile; filaments red, 6–7 mm, glabrous, incrassate towards base; anthers broader than long, 1–1.5 mm; staminodes 6–8, of varying length, the longest c. 4 mm. *Ovary* c. 4 mm, stipe 2–3 mm; style filiform, 5–7 mm, all glabrous; stigma capitate, 1 mm. *Pods* unknown.

Distribution — *Malesia*: Borneo (coastal zone of W Borneo from Kuching in North to Matand in South).

Note — Easily recognizable, also vegetatively, by the characteristic, coriaceous leaves which show a remarkable similarity with the leaves of several *Menispermaceae*.

65. *Bauhinia posthumi* (de Wit) Cusset

Bauhinia posthumi (de Wit) Cusset, *Adansonia* 6 (1966) 279. — *Phanera posthumi* de Wit, *Reinwardtia* 3 (1956) 515. — Type: *Posthumus 914a* (BO holo; L).

Large, tendrilled climber; all young parts glabrous; young branches terete, not striate. *Leaves*: stipules early caducous (not observed); petioles slender, 0.5–2 cm; lamina coriaceous, entire, ovate-elliptic, 7–8 by 4–5 cm; apex acute to acuminate; base shallowly cordate to rounded; both surfaces glabrous, dull; nerves 5–7. *Inflorescences* terminal or lateral, slender racemes, sometimes aggregate forming compressed, leafy panicles up to 25 cm long; axis terete, glabrous; pedicels first greyish brown silky pubescent, later glabrous, 6–9.5 cm; bracts and bracteoles early caducous (not seen); bracteoles not opposite, inserted about the middle of the pedicel. *Buds* subglobose, apiculate, strongly ribbed, c. 8 mm across, sparsely pubescent, soon glabrous. *Hypanthium* broad tubular, strongly ribbed, 5–8 mm long, glabrescent. *Calyx* splitting into 2 or 3 more or less reflexed lobes. *Petals* unequal-sided, suborbicular with crenate-undulate margin, outside densely rusty pubescent, c. 2.5 cm including the 5 mm claw. *Stamens* 2 (or 3) fertile; filaments fleshy, glabrous, c. 10 mm; anthers ellipsoid, pore opening large; staminodes about 7–10, fleshy, glabrous, up to 6 mm. *Ovary* glabrous, c. 7 mm, on a c. 5 mm long, glabrous stipe; style glabrous, 2–3 mm; stigma peltate. *Pods* unknown.

Distribution — *Malesia*: Sumatra, so far only known from Mt Ketiduran, Jambi.

Habitat — Collected at 140 m altitude.

Note — This remarkable species is only known from the type collection. It is related to *Bauhinia lucida*, which has not been collected in Sumatra but does occur on Siberut Island, W of Sumatra. It has larger inflorescences, larger buds and longer pedicels.

66. *Bauhinia pyrrhoneura* Korth.

Bauhinia pyrrhoneura Korth., *Kruidk.* (1841) 88, pl. 11 ('pyrraneura'). — *Phanera pyrrhoneura* (Korth.) Benth. in *Miq.*, *Pl. Jungh.* (1852) 262; *Miq.*, *Fl. Ind. Bat.* 1, 1 (1855) 63; de Wit, *Reinwardtia* 3 (1956) 516. — Type: *Korthals s.n.* (L sh. 908.112-622 holo; K, S, U, W).

Bauhinia xanthoneura Korth. in *Miq.*, *Fl. Ind. Bat.* 1, 1 (1855) 63. — Types: *Korthals s.n.* (L sh. 908.112-631 / 925.250-577), Sumatra.

Phanera catalpaefolia *Miq.*, *Fl. Ind. Bat.* 1, 1 (1858) 1079. — Type: *Teijsmann HB 856* (U holo), Sumatra.

Phanera acuminatissima *Miq.*, *Fl. Ind. Bat.*, *Suppl.* (1861) 287. — Type: *Teijsmann HB 888* (U holo; K), Sumatra.

Tendrilled *climber*; young branches ribbed, rusty tomentose. *Leaves*: stipules oblong, rounded, 3 cm (?) long, pubescent, early caducous (from De Wit, not seen by us); petiole rusty tomentose, 4–7 cm; lamina entire, broadly ovate to suborbicular, up to 22 by 18 cm; apex often caudate, finely emarginate at apex, 5–30 mm long; nerves (7–)9–11; upper surface glabrous, lower thinly appressed puberulous to almost glabrous, rusty tomentose on the nerves. *Inflorescences* large, composed of corymbs, all parts rusty tomentose, main axis angulate, c. 10 cm; pedicels 4–5 cm; bracts not seen; bracteoles setaceous, minute, inserted in the lower half of the pedicel. *Buds* ovoid, apiculate, rusty tomentose, with 5 longitudinal furrows, 7–10 mm. *Hypanthium* distinctly striate with ridges continuing on the pedicel, 3–5 mm; in dried specimens often slightly curved. *Calyx* splitting into 2 or 3 reflexed lobes. *Petals* yellow, broadly ovate to orbicular, with undulate margin, outside hairy, 2–3(–4) cm long, abruptly clawed; claw 2–3 mm. *Stamens* 3 fertile; filaments glabrous, thick, curved, c. 5 mm long; anthers broad ellipsoid, c. 2 mm; staminodes 5–10, 3–4 mm. *Ovary* shortly stipitate, hairy along the sutures, c. 12 mm; style 5 mm, hairy, glabrous towards the peltate stigma. *Pods* unknown.

Distribution — *Malesia*: Sumatra (known from few localities: Mt Melintang, Lubuk-sikaping, Lubukalung, Ack Bila Marbu).

Notes — 1. The epithet was published as '*pyrraneura*'; later authors changed it to the spelling maintained here.

2. The type collection consists of ample material, while the specimens seen of *Bauhinia xanthoneura*, *Phanera catalpaefolia*, and *P. acuminatissima* consist of few large leaves only. The largest leaves probably are taken from the lower part of the flowering shoots or from sterile branches.

67. *Bauhinia wrayi* Prain

Bauhinia wrayi Prain, J. As. Soc. Beng. 66, ii (1897) 191, 497; Ridley, Fl. Malay Penins. 1 (1922) 632. — *Phanera wrayi* (Prain) de Wit, Reinwardtia 3 (1956) 517. — Type: *King's Coll.* 5243 (K holo; CAL, E), Perak.

Bauhinia moultonii Merr., Philipp. J. Sc., Bot. 11 (1916) 82. — *Phanera moultonii* (Merr.) de Wit, Reinwardtia 3 (1956) 513. — Type: *Native coll.* BS 202 (A holo; K), Sarawak.

Bauhinia cardiophylla Merr., Philipp. J. Sc., Bot. 11 (1916) 79. — *Phanera cardiophylla* (Merr.) de Wit, Reinwardtia 3 (1956) 501. — Type: *Native coll.* 1858 (A holo), Sarawak.

Bauhinia cancellata Ridley, Kew Bull. (1929) 256. — *Phanera wrayi* var. *cancellata* (Ridley) de Wit, Reinwardtia 3 (1956) 518. — Type: *Nur 11559* (K holo), Negri Sembilan.

Bauhinia rosulenta Ridley, Kew Bull. (1929) 256. — Type: *Haviland 927* (K holo).

Phanera moultonii var. *rubella* de Wit, Reinwardtia 3 (1956) 515. — Type: *Buwalda 6737* (BO holo; K, L), Sumatra.

Tendrilled *climber* with slender branches. *Leaves* entire to more or less deeply divided; stipules tiny, early caducous, 1–2 mm; petioles slender, 1–4 cm; lamina varying in shape, 2–9 cm long; 5–13-nerved; glabrous or pubescent. *Inflorescences* lateral and terminal corymbs, often elongating during anthesis, up to 10 cm; pedicels filiform, 3–4 cm; bracts subulate, 1–2 mm; bracteoles tiny, inserted about the middle of the pedicel. *Buds* globose, apiculate, 3–5 mm. *Hypanthium* tubular, 2–3 mm. *Calyx* splitting into 2–3(–4) reflexed lobes. *Petals* yellowish-white with a red patch at the claw, subequal.

obovate to lanceolate, with crenulate margin, 10–11 mm, with a distinct claw, usually pubescent on the dorsal side. *Stamens* 3 fertile; filaments glabrous, c. 5 mm; anthers ellipsoid; reduced stamens with small anthers and staminodes 5–7, shorter than or equal to the fertile ones. *Ovary* distinctly stipitate, c. 2 mm, glabrous or, rarely, hairy along the suture or all over; stipe c. 1 mm, with a tuft of ferrugineous hairs at base; style c. 1.5 mm; stigma small, capitate. *Pods* ovate oblong, glabrous, woody, shortly stipitate, 6–10 by 2–3 cm. *Seeds* 1–3, broadly ovate, compressed.

Distribution — *Malesia*: Sumatra, Malay Peninsula (C and S part), Borneo.

Note — This is a very variable species with regard to indumentum and leaf shape; this has led to the description of several taxa. We have maintained some of these as varieties. Transitional forms between several of them do occur.

KEY TO THE VARIETIES

- 1a. Ovary glabrous or nearly so, stipe often hairy, sometimes with a tuft of reddish hairs at mouth of hypanthium; leaves entire, emarginate or bifid 2
- b. Ovary and stipe hairy all over; leaves entire **b. var. blumeana**
- 2a. Pedicels and buds glabrous or slightly pubescent; leaves 5–9-nerved, nerves thin beneath 3
- b. Pedicels and buds hairy or sparsely puberulous; leaves 7–13-nerved, nerves prominent beneath **f. var. moultonii**
- 3a. Leaves entire, rarely emarginate 4
- b. Leaves entire, emarginate or bifid 6
- 4a. Leaves ovate with truncate to shallowly cordate base, 5-nerved, apex acuminate, entire **a. var. wrayi**
- b. Leaves cordate to broadly ovate with cordate base, 7–9-nerved, apex acuminate, entire or slightly emarginate 5
- 5a. Leaves glabrous, cordate, often glaucous beneath **c. var. cardiophylla**
- b. Leaves hairy beneath, sometimes only on the nerves or petiole, cordate to broadly ovate **c. var. borneensis**
- 6a. Leaves 2/5 bifid, tip of lobes obtuse, 9-nerved **g. var. rubella**
- b. Leaves entire, emarginate to 1/2 bifid, tip of lobes obtuse to acute, 5–7-nerved ..
..... **d. var. cancellata**

a. var. wrayi

Bauhinia wrayi var. *sumatrana* Ridley, Kew Bull. (1925) 80.

The typical variety is recognizable by *leaves* ovate, entire, 3–7 cm long, 5-nerved, nerves thin beneath; apex acuminate, base truncate to shallowly cordate, lower surface appressed rusty pubescent later glabrescent or glabrous; *pedicels* and *buds* glabrous or sparsely pubescent.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia.

Habitat — In various types of forests and open land, usually at lower altitudes.

Note — Var. *sumatrana* was described from Bengkulu Range, Lubok Tandai. It is quite different from the Sumatra collections from Leuser National Park, which we have described as var. *blumeana* (see below).

b. var. *blumeana* K. & S.S. Larsen

Bauhinia wrayi Prain var. *blumeana* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 662. — Type: *Whitmore 3342* (K holo; L), Sumatra.

Leaves entire, ovate; nerves 5(–7); apex rounded to acute, sometimes slightly emarginate with a short mucro; upper surface glabrous or sparsely pubescent; lower rusty pubescent, denser on the nerves. *Inflorescences* rusty pubescent. Deviates from all other varieties by the *ovary* being hairy all over.

Distribution — *Malesia*: endemic to N Sumatra.

Habitat — Montane forest, altitude 1200 m.

c. var. *borneensis* K. & S.S. Larsen

Bauhinia wrayi Prain var. *borneensis* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 662. — Type: *Meijer SAN 47492* (L holo; K, SAN), Sabah.

Leaves cordate to broadly ovate, 3–8 cm long, 7–9-nerved; base cordate; apex rounded, acute to acuminate, entire or slightly emarginate; underside reddish brown hairy, sometimes only on the nerves and the petiole. *Pedicels* and *buds* glabrous or sparsely pubescent.

Distribution — *Malesia*: endemic to Sabah and adjacent Kalimantan.

Habitat — Lowland evergreen forest.

Note — The holotype is a fruiting specimen; *Meijer 2407* (K, L) from Nunakan I., N of Tarakan, is a flowering branch, regarded as paratype.

d. var. *cancellata* (Ridley) K. & S.S. Larsen

Bauhinia wrayi Prain var. *cancellata* (Ridley) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 662. — *Bauhinia cancellata* Ridley — *Phanera wrayi* var. *cancellata* (Ridley) de Wit.

This variety and var. *rubella* are morphologically rather close in having the pedicels and buds glabrous or nearly so. They differ, however, conspicuously in leaf shape. Var. *cancellata*, a mountain endemic, has ovate leaves which on the same shoot can vary from entire to bilid 1/3–1/2, tip of lobes obtuse to acute, with 5–7 nerves, while var. *rubella* has leaves broader than long, \pm subreniform, divided less than 1/2, with tip of lobes obtuse, and with 9 nerves.

Distribution — *Malesia*: Malay Peninsula (Negri Sembilan), only known from the type locality.

Habitat — Mountain forest, 800–900 m altitude.

e. var. *cardiophylla* (Merr.) K. & S.S. Larsen

Bauhinia wrayi Prain var. *cardiophylla* K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 662. — *Bauhinia cardiophylla* Merr. — *Phanera cardiophylla* (Merr.) de Wit.

Deviates from all other varieties by its entire, cordate, glabrous leaves, c. 7 cm long, often glaucous beneath; nerves 7–9; pedicels and buds glabrous.

Distribution — *Malesia*: Borneo (Brunei, Sarawak).

Habitat — Lowland forest.

f. var. *moultonii* (Merr.) K. & S.S. Larsen

Bauhinia wrayi Prain var. *moultonii* (Merr.) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 662. — *Bauhinia moultonii* Merr. — *Bauhinia rosulenta* Ridley — *Phanera moultonii* (Merr.) de Wit.

The leaves of this variety are very variable, broad ovate to orbicular, generally larger than in the other varieties, 4–9 cm across, and with the apex varying from entire, emarginate, to bifid; underside rusty pubescent, particularly on the nerves; nerves 7–13, prominent beneath. Pedicels and buds hairy.

Distribution — *Malesia*: Borneo.

Habitat — In swamp forest and on sandy soil, also on sandstone and heath forests, up to 800 m altitude.

g. var. *rubella* (de Wit) K. & S.S. Larsen

Bauhinia wrayi Prain var. *rubella* (de Wit) K. & S.S. Larsen, Nord. J. Bot. 13 (1993) 662. — *Phanera moultonii* var. *rubella* de Wit.

See under var. *cancellata*.

Distribution — *Malesia*: Sumatra.

Habitat — Lowland primary forest.

Note — A specimen from the summit zone of Peëut Sago, *Gall 104* (K, L) (Aceh, N Sumatra) has leaves with the tips of the lobes acute. With some hesitation we have referred it to this variety.

Section *Tubicalyx*

Bauhinia sect. *Tubicalyx* Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 23. — *Lasiobema* (Korth.) Miq., Fl. Ind. Bat. 1, 1 (1855) 71 sensu de Wit, Reinwardtia 3 (1956) 430, p.p.

Tendrilled *lianas*. *Leaves* entire. *Hypanthium* turbinate. *Calyx* campanulate, 5-dentate, open at apex before anthesis; nectariferous disc absent. Fertile *stamens* 3; anthers opening by a longitudinal slit. *Pod* woody dehiscent. *Seeds* with short funicular arillobes.

Distribution — 4 species in SE Asia.

KEY TO THE SPECIES

- a. Pedicels glabrous or nearly so; racemes rusty puberulous; bracteoles scalelike; calyx 4 mm long, petals red **68. *B. strychnoidea***
- b. Pedicels pubescent; racemes greyish silky pubescent; bracteoles threadlike; calyx 2 mm long, petals green **69. *B. tubicalyx***

68. *Bauhinia strychnoidea* Prain

Bauhinia strychnoidea Prain, J. As. Soc. Beng. 66, ii (1897) 195; Ridley, Fl. Malay Penins. 1 (1922) 633; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 24. — *Lasiobema strychnoideum* (Prain) de Wit, Reinwardtia 3 (1956) 429. — Type: *Kunstler 5914* (not *5194* as cited by De Wit) (K lecto; SING, US).

Slender, tendrilled *liana* or climbing *shrub*, up to 30 m; stems not more than 2–3 cm diam.; young branches and tendrils glabrous, sulcate. *Leaves* entire, coriaceous; stipules minute, very early caducous; petiole slender 1–3 cm, glabrous; lamina ovate to lanceolate, 4–11 by 2.5–8 cm, 3–5-nerved; entire, apex ± acuminate, base rounded to cuneate; both sides glabrous, upper side glossy. *Inflorescences* terminal and lateral racemes, dense-flowered, up to 30 cm long, ± rusty tomentose to almost glabrous; pedicels slender, glabrous or nearly so, c. 2 cm long; bracts subulate, 2–3 mm long; bracteoles very minute, scaly, inserted about the middle of the pedicel. *Buds* small, globose. *Hypanthium* short turbinate. *Calyx* campanulate, 4 mm long, with 5 minute teeth. *Petals* red, spatulate, subequal, 7–8 mm including the short claw, glabrous outside, ± silky hairy inside along the midnerve. *Stamens* 3; filaments c. 7 mm long, glabrous; anthers 1.5 mm; staminodes 2, c. 4 mm long, and 2 or 3 minute, subulate. *Ovary* c. 4 mm long, very shortly stipitate, densely rusty hairy; style 2 mm, glabrous towards apex; stigma oblique, peltate. *Pods* flat, woody, densely velvety, c. 11 by 3–6 cm. *Seeds* 1–4, flat, orbicular, glossy, black, 1.5 cm diam.

Distribution — *Malesia*: Malay Peninsula (Perak, Kelantan, Pahang, Selangor, Negri Sembilan).

Habitat — Seems to be confined to limestone hills at lower altitudes.

69. *Bauhinia tubicalyx* Craib

Bauhinia tubicalyx Craib, Kew Bull. (1928) 64; Fl. Siam. Enum. 1 (1928) 531; Larsen & Larsen, Nat. Hist. Bull. Siam. Soc. 25 (1973) 18; in Fl. Thailand 4 (1984) 27, f. 6/1–3; Wunderlin, Larsen & Larsen, Biol. Skr. Dan. Vid. Selsk. 28 (1987) 23. — *Lasiobema tubicalyx* (Craib) de Wit, Reinwardtia 3 (1956) 430, f. 9. — Type: *Kerr 12407* (K holo; ABD, BK, E), Thailand.

Slender tendrilled *liana*; young branches greyish pubescent, later glabrous. *Leaves*: stipules minute, early caducous; petiole slender, 1–4 cm, glabrescent; lamina ovate-oblong, chartaceous, 5–11 by 2.5–5 cm, 3-nerved; entire, apex acuminate, base rounded to cuneate, both sides glabrous. *Inflorescences* terminal and lateral racemes, mainly unbranched, many-flowered, up to 20 cm long; grey silky-pubescent; pedicels 1.5–20

mm, pubescent; bracts subulate, 2–3 mm, greyish pubescent; bracteoles minute, capillary, inserted at about the middle of the pedicel. *Buds* small, globose, greyish pubescent, 2–3 mm including the very short hypanthium. *Calyx* campanulate with 5 minute teeth. *Petals* green, spatulate, subequal, c. 5 mm long including the short claw, glabrous outside, \pm silky hairy inside. *Stamens* 3; filaments slightly longer than petals; anthers 1.5–2 mm; staminodes 7, minute, subulate. *Ovary* densely silky hairy, c. 3 mm long, on a short stipe; style 2 mm, glabrous below stigma; stigma oblique, discoid. *Pods* unknown.

Distribution — Endemic to southernmost Peninsular Thailand; might be expected further south on the Malay Peninsula.

Habitat — On limestone rocks in evergreen forests at lower altitudes.

DOUBTFUL SPECIES

Bauhinia cordifolia Roxb., Fl. Ind., ed. Carey, 2 (1824) 332. — Type unknown.

This species described from the Moluccas and by Baker referred to *Bauhinia emarginata* Jack, belongs undoubtedly to *B. finlaysoniana* regarding leaf shape and nerves, and the locality. It cannot be placed in one of the varieties.

Bauhinia emarginata Jack, Mal. Misc. 2 (1822) 75, nom. illeg., non Miller

De Wit, Reinwardtia 3 (1956) 499, placed this name as a synonym under *Bauhinia bidentata*, mentioning that it had not been possible to trace the type. In the protologue the leaves are described as “cordate, subrotund-oval terminating in a short, blunt, emarginate acumen, very entire.” This suggests in our opinion *Bauhinia pyrrhoneura* which also matches the geographic location Sumatra.

Bauhinia parvifolia Teijsm. & Binnend., Nat. Tijdschr. Ned. Ind. 29 (1867) 257.

According to De Wit, Reinwardtia 3 (1956) 537, this name is represented by sterile herbarium specimens in BO, in our opinion probably belonging to *Bauhinia corymbosa*.

Phanera dasycarpa Miq., Fl. Ind. Bat. 1, 1 (1858) 1078.

See Note 1 under *Bauhinia rahmatii* Merr. (p. 489).

EXCLUDED SPECIES

Bauhinia cucullata Desv., J. Bot., ed. Desv. 3 (1814) 74; Zoll., Nat. Geneesk. Arch. Nêrl. Indië 3 (1846) 69.

A South American species not occurring in the Malesian area; see de Wit, Reinwardtia 3 (1956) 535.

Bauhinia inermis Perr., Mém. Soc. Linn., Paris 3 (1902) 1824, nom. nud., nom. illeg. non Forssk. nec Pers.; de Wit, Reinwardtia 3 (1956) 536.

Described as a species from the Philippine mountains.

Bauhinia latisiliqua Cav., Ic. 5 (1799) 5, pl. 407; de Wit, Reinwardtia 3 (1956) 536.

A name based on a collection consisting of leaves of a *Bauhinia* and a fruit of a *Caesalpinia*.

Bauhinia lunaria Cav., Ic. 5 (1799) 5, pl. 407; de Wit, Reinwardtia 3 (1956) 536.

A South American species belonging to section *Casparea*.

Bauhinia retusa Roxb., Fl. Ind., ed. Carey, 2 (1832) 322. — *Lasiobema retusa* (Roxb.) de Wit, Reinwardtia 3 (1956) 538.

An Indian species erroneously ascribed to Luzon by Fernandez-Villar, Nov. App. (1880) 72.

Bauhinia rufa (Grah. ex Benth.) Baker in Hook. f., Fl. Brit. India 2 (1878) 280, non Steud. — *Phanera rufa* Benth. in Miq., Pl. Jungh. (1852) 263.

An Indian species erroneously ascribed to the Philippines by Fernandez-Villar, Nov. App. (1880) 72. The correct name of this species is *Bauhinia ornata* Kurz.

Bauhinia subrotundifolia Cav., Ic. 5 (1799) 4, pl. 406; Naves in Blanco, Fl. Filip., ed. 3 (1877) pl. 82; Fern.-Vill., Nov. App. (1880) 72; Vidal, Rev. Pl. Vasc. Filip. (1886) 117.

A South American species belonging to section *Casparea*, erroneously ascribed to the Philippines by various authors.

CAESALPINIA

(Ding Hou)

Caesalpinia L., Sp. Pl. (1753) 380; Gen. Pl., ed. 5 (1754) 178 ('*Caesalpina*'); Hattink, Reinwardtia 9 (1974) 9; Polhill & Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 93; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 16. — Type species: *Caesalpinia brasiliensis* L.

Poinciana L., Sp. Pl. (1753) 380; Gen. Pl., ed. 5 (1754) 178. — Type species: *Poinciana pulcherrima* L. [= *Caesalpinia pulcherrima* (L.) Schwartz].

Guilandina L., Sp. Pl. (1753) 381; Gen. Pl., ed. 5 (1754) 179; Miq., Fl. Ind. Bat. 1, 1 (1855) 113. — Type species: *Guilandina bonduc* L. [= *Caesalpinia bonduc* (L.) Roxb.].

Cinclidocarpus Zoll., Nat. Geneesk. Arch. Neêrl. Indië 3 (1846) 81. — Type species: *Cinclidocarpus nitidus* Zoll. [= *Caesalpinia tortuosa* Roxb.].

Mezoneuron Desf., Mém. Mus. Hist. Nat. Paris 4 (1818) 245; Prain, J. As. Soc. Beng. 66, ii (1897) 130; Backer & Bakh. f., Fl. Java 1 (1964) 546. — Type species: *Mezoneuron pubescens* Desf. [= *Caesalpinia pubescens* (Desf.) Hattink].

Trees, shrubs, lianas or scramblers, usually armed with spines or prickles, rarely unarmed. *Stipules* present or absent, minute to large and leafy, caducous or persistent. *Leaves* alternate, rarely opposite (*C. oppositifolia*), bipinnate, usually paripinnate, rarely imparipinnate, petioled; pinnae opposite; rachides on the underside often with prickles. *Leaflets* opposite or alternate, sessile or shortly petiolulate. *Inflorescences* axillary and

then often serial, and/or terminal, racemose or paniculate; bracts mostly caducous; bracteoles absent. *Flowers* usually bisexual, sometimes unisexual, zygomorphic, often all parts punctate (secretory cavities), pedicelled. *Hypanthium* usually obliquely short-cupular or funnel-shaped, persistent or shed. *Sepals* 5, usually united at the base, unequal, the lower one usually cucullate, longer than the others and clasping them, often reflexed during anthesis. *Petals* 5, unequal, often spatulate, the limb usually (sub)orbicular or oblong, sometimes contracted towards the basal part into a narrow claw; the upper one (standard) mostly deviating from others in both shape and size, sometimes with a liguliform appendage. *Disk* obscure or absent. *Stamens* 10, free, equal or alternately longer or shorter; filaments usually hairy at the lower half or at the base; anthers dorsifixed, glabrous or rarely villose, laterally longitudinally dehiscent. *Pistil* sessile or shortly stipitate; ovary oblique at the base, flat, 1–10(–13)-ovuled; style slender, more or less curved upwards; stigma terminal, oblique, usually funnel-shaped or sometimes slightly bilobed, ciliate or glabrous. *Pods* very variable, dehiscent or indehiscent, usually more or less flattened, winged along the upper suture or wingless, unarmed or rarely spiny, sometimes twisted, 1–10(–13)-seeded. *Seeds* orbicular or globose, ellipsoid or reniform, sometimes flattened, often smooth, usually exalbuminous.

Distribution — Pantropical, c. 100 species; all over *Malesia* with 18 indigenous species, 1 in Solomon Islands but not yet found in *Malesia* proper (*C. solomonensis*), 3 introduced and now wide-spread (*C. coriacea*, *C. pulcherrima*, *C. sappan*) and 2 occasionally cultivated, not treated here: *C. spicaria* Dalz. and *C. spinosa* (Molina) Kuntze.

Habitat — Mostly in (secondary) scrub-vegetation, sometimes coastal, rarely in primary forest, often in seasonally dry country, but sometimes also under everwet conditions, on various types of soil from sea level to c. 1700(–2000) m altitude. Some species appear to have a considerable ecological range.

Note — The present treatment of *Caesalpinia* is chiefly based on the comprehensive revision published by Hattink [Reinwardtia 9 (1974) 1–69].

KEY 1 TO THE SPECIES

(Based on flowering specimens)

(Flowers of *C. solomonensis* not yet known)

- 1a. Leaves opposite. Stipules interpetiolar, persistent, up to 35 mm long **14. *C. oppositifolia***
- b. Leaves alternate. Stipules (if present) not interpetiolar, often caducous, usually minute or small, 0.5–5(–20) mm long 2
- 2a. Pedicels long, 70–100 mm. Filaments long, 55–75 mm .. **17. *C. pulcherrima***
- b. Pedicels much shorter, less than 30 mm. Filaments much shorter, 5–30 mm .. 3
- 3a. Branches or branchlets unarmed. Leaves imparipinnate. (Cultivated) **3. *C. coriaria***
- b. Branches or branchlets usually armed with recurved prickles. Leaves paripinnate 4

- 4a. Stipules pinnately lobed, the lobes 5–20 mm long **2. *C. bonduc***
 - b. Stipules absent or (if present) not lobed, 0.5–4(–20) mm long 5
- 5a. Petals with the standard distinctly 2-lobed to about half of its length, not contracted into a narrow claw towards the basal part 6
 - b. Petals with the standard not lobed, usually contracted into a narrow claw at the basal part 7
- 6a. Leaflets 4 or 5 pairs per pinna. Pedicels 3–6 mm. Ovary 1- or 2-ovuled **5. *C. cucullata***
 - b. Leaflets 6–8 pairs per pinna. Pedicels 10–20 mm. Ovary 6–17-ovuled **11. *C. latisiliqua***
- 7a. Leaflets 2–4 pairs per pinna **4. *C. crista***
 - b. Leaflets 6 or more pairs per pinna 8
- 8a. Leaflets sessile or subsessile (petiolules less than 0.5 mm) 9
 - b. Leaflets with petiolules more than 0.5 mm 13
- 9a. Petals with the standard emarginate at the top **7. *C. digyna***
 - b. Petals with the standard rounded or obtuse at the top 10
- 10a. Pedicels articulated at the base **22. *C. tortuosa***
 - b. Pedicels articulated near the top 11
- 11a. Pedicels 4–11 mm **15. *C. parviflora***
 - b. Pedicels 15–20 mm 12
- 12a. Ovary 1- or 2-ovuled **13. *C. mindorensis***
 - b. Ovary 3–6-ovuled **18. *C. sappan***
- 13a. Leaflets alternate 14
 - b. Leaflets opposite 15
- 14a. Pedicels 6–10 mm. Petals 9–10 mm long. Filaments 12–14 mm. Ovary 4-ovuled **1. *C. andamanica***
 - b. Pedicels 3–5 mm. Petals 4–6 mm long. Filaments c. 7 mm. Ovary 1- or 2-ovuled **19. *C. scortechinii***
- 15a. Stipules 8–13 mm long. Ovary 8–10-ovuled **6. *C. decapetala***
 - b. Stipules absent or much shorter, up to 2 mm long. Ovary (2–)4–6(–8)-ovuled 16
- 16a. Ovary hairy 17
 - b. Ovary glabrous 18
- 17a. Hypanthium 3 mm wide. Filaments 6–7 mm **12. *C. major***
 - b. Hypanthium 7–8 mm wide. Filaments 12–15 mm **16. *C. pubescens***
- 18a. Petals with the claw prolonged into a bilobed ligule 19
 - b. Petals without a ligule as above 20
- 19a. Flower buds glabrous. Lower sepal 4–6 by 3–4 mm **8. *C. enneaphylla***
 - b. Flower buds hairy. Lower sepal 9–10 by 5 mm **10. *C. hymenocarpa***
- 20a. Hypanthium 2 mm deep and 7–8 mm wide. Lower sepal c. 15 mm long **9. *C. furfuracea***
 - b. Hypanthium 3–7 mm deep and 4–8 mm wide. Lower sepal 4–10 mm long **21. *C. sumatrana***

KEY 2 TO THE SPECIES

(Based on fruiting specimens)

- 1a. Pods wingless or with a narrow wing up to 6 mm wide along the upper margin 2
- b. Pods with a distinct wing 6–20 mm wide along the upper margin 14
- 2a. Leaves opposite. Stipules interpetiolar, persistent, up to 35 mm long. Pods dehiscent, 2-seeded **14. C. oppositifolia**
- b. Leaves alternate. Stipules absent or (if present) not interpetiolar, often caducous, usually minute or small, 0.5–5(–20) mm long 3
- 3a. Pedicels long, 70–100 mm. Pods dehiscent, 8–10-seede . **17. C. pulcherrima**
- b. Pedicels much shorter, less than 30 mm 4
- 4a. Branches and branchlets unarmed. Leaves often imparipinnate. Pods coiled or twisted. (Cultivated.) **3. C. coriaria**
- b. Branches and branchlets usually armed with recurved prickles. Leaves paripinnate 5
- 5a. Pods armed with spines 6
- b. Pods smooth, not spiny 7
- 6a. Stipules pinnately lobed, lobes up to 20 mm long **2. C. bonduc**
- b. Stipules not lobed, minute or very small, up to 3 mm long **12. C. major**
- 7a. Leaves with 2–4 pairs of leaflets per pinna **4. C. crista**
- b. Leaves with 6 or more pairs of leaflets per pinna 8
- 8a. Pods indehiscent 9
- b. Pods dehiscent 12
- 9a. Pods woody. Seeds large, 18–30 mm long or in diam. 10
- b. Pods fleshy. Seeds smaller, 10–12 mm in diam. 11
- 10a. Pods large, 10–12 by 7.5–8 cm, 2-seeded. Seeds suborbicular, 25–30 mm in diam. (Solomon Islands.) **20. C. solomonensis**
- b. Pods smaller, 3–5 by 2–3 cm, 1-seeded. Seeds reniform, c. 18 by 15 mm
..... **19. C. scortechinii**
- 11a. Leaflets 7–12 pairs per pinna. Pods 3.5–5 cm long, not twisted, 1–3(–4)-seeded
..... **7. C. digyna**
- b. Leaflets 12–40 pairs per pinna. Pods 3.5–9 cm long, often twisted, 1–5(–7)-seeded
..... **22. C. tortuosa**
- 12a. Pods oblong in outline, acute at the apex, 4–9-seeded. Seeds ellipsoid, 8–12 by 6–8 mm
..... **6. C. decapetala**
- b. Pods slightly obovate-oblong, more or less truncate or obtuse at the apex 13
- 13a. Pods 1- or 2-seeded. Seeds orbicular, up to 20 mm in diam. **15. C. parviflora**
- b. Pods 2–4-seeded. Seeds ellipsoid, 15–18 by 8–11 mm. (Cultivated.)
..... **18. C. sappan**
- 14a. Pods 1- (or 2-)seeded 15
- b. Pods (1–)3–9(–13)-seeded 16
- 15a. Leaflets 3–6 pairs per pinna. Pods acuminate at the apex. Pedicels 10–15 mm, articulated about 1/3 from the top **5. C. cucullata**

- b. Leaflets 16–24 pairs per pinna. Pods rounded at the apex. Pedicels 8–15 mm, articulated near the top **13. *C. mindorensis***
- 16a. Seeds compactly arranged in the middle of the pod, the number of seeds not countable from outside **16. *C. pubescens***
- b. Seeds spaciouly arranged in the pod, the number of seeds well countable from outside 17
- 17a. Pedicels articulated at the base. Branches and branchlets unarmed or with a few prickles 18
- b. Pedicels articulated near the top. Branches and branchlets usually armed with prickles 19
- 18a. Hypanthium usually as deep as wide, glabrous. Pods 1–8-seeded **21. *C. sumatrana***
- b. Hypanthium usually wider than deep, hairy or glabrous. Pods 6–9(–13)-seeded **11. *C. latisiliqua***
- 19a. Leaflets alternate **1. *C. andamanica***
- b. Leaflets usually opposite, rarely associated with some subopposite ones 20
- 20a. Pedicels hairy. Hypanthium usually shed, hairy **10. *C. hymenocarpa***
- b. Pedicels glabrous or sometimes with a few hairs. Hypanthium glabrous, rarely shed 21
- 21a. Pods shining, 4–6-seeded. Hypanthium with the margin not recurved; wing 7–10 mm wide **8. *C. enneaphylla***
- b. Pods dull, 3- or 4-seeded. Hypanthium with the margin recurved; wing 10–20 mm wide **9. *C. furfuracea***

1. *Caesalpinia andamanica* (Prain) Hattink

Caesalpinia andamanica (Prain) Hattink, Reinwardtia 9 (1974) 15, f. 4/1; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 48, pl. 7/13–16; in Fl. Thailand 4 (1984) 79, f. 20/13–16. — *Mezoneuron andamanicum* Prain, J. As. Soc. Beng. 61, ii (1892) 131; *ibid.* 66, ii (1897) 234. — Type: *Prain s.n.* (CAL holo, K), S Andaman.

Mezoneuron kunstleri Prain, J. As. Soc. Beng. 66, ii (1897) 233; Ridley, Fl. Malay Penins. 1 (1922) 647. — Type: *King's Coll. (Kunstler)* 895 (CAL holo, K), Malaya.

Liana up to 20 m, glabrous in all vegetative parts, prickles recurved, 2–6 mm long. *Stipules* caducous, scale-like, 0.5 by 2 mm, acute, appressed. *Leaves*: rachis 15–50 cm long; pinnae 2–6 pairs, 7–16 cm long, ending in c. 1 mm long tip. *Leaflets* alternate, sometimes subopposite towards the top of a pinna, 6–10 per pinna, petiolulate (2–3 mm), membranous, oblong-elliptic, rarely obovate, 1.5–6 by 1–3.5 cm, base cuneate, apex obtuse to rounded, sometimes somewhat retuse. *Racemes* axillary and terminal, paniculate, 25–50(–75) cm long, the rachis puberulous or glabrous; pedicels 6–10 mm, articulated 1–2 mm below the top. Flower buds glabrous. *Hypanthium* symmetric, 1–2 by 4(–6) mm. *Sepals* 4–12 by 6 mm. *Petals* spreading, obovate or elliptic, 9–10 by 5–7 mm, shortly clawed, glabrous. *Stamens* exserted; filaments 12–14 mm; anthers 3 mm long. *Pistil* glabrous; stipe 1 mm, ovary c. 4 by 1 mm, 4-ovuled; style c. 12 mm; stigma

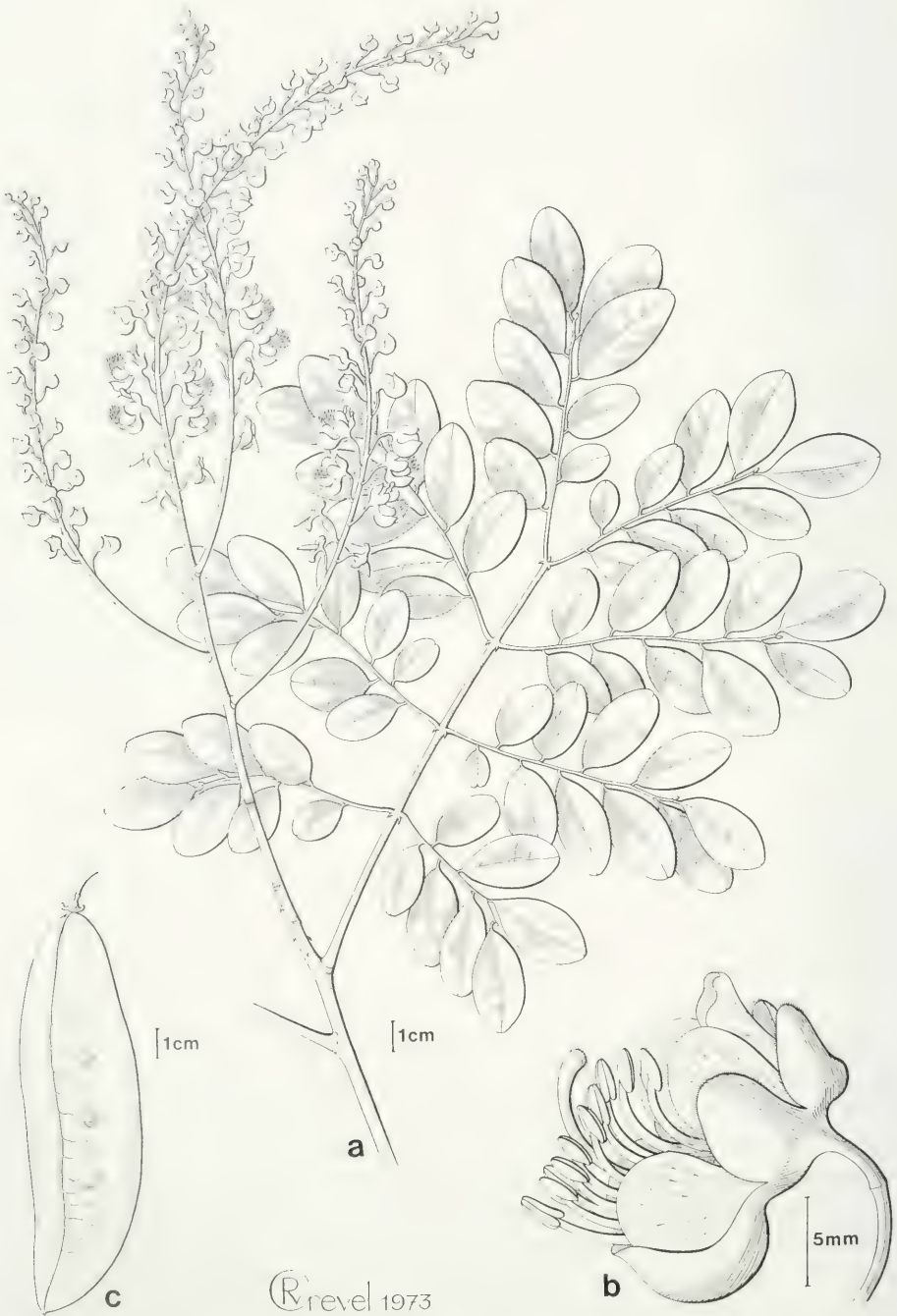


Fig. 19. *Caesalpinia andamanica* (Prain) Hattink. a. Flowering branch; b. flower; c. pod (a: *King's Coll.* 895 & *Jacobs* 8470; b: *Jacobs* 8470; c: *SF* 6941). Drawing R. van Crevel.

somewhat bilobed, ciliate. *Pods* indehiscent, 1–15 by 2.5–4 cm (incl. 9–12 mm wide wing), often strongly reticulate, base cuneate, apex acute. *Seeds* 3 or 4, spaced, ovate in outline, flat, c. 11 by 6 mm, brown, smooth. — **Fig. 19.**

Distribution — Burma (Tenasserim), India (S Andamans), Thailand (Peninsula, Kaw Chang, Pang-nga, Surat); *Malesia*: Sumatra (Lampung), Malay Peninsula (Perlis, Perak, Salak, Ipoh).

Habitat & Ecology — In scrub, evergreen primary forest, along rivers and roads, up to 500 m altitude. Fl. May, Oct.; fr. Oct.–March.

2. *Caesalpinia bonduc* (L.) Roxb.

Caesalpinia bonduc (L.) Roxb., Fl. Ind., ed. Carey, 2 (1832) 362; emend. Dandy & Exell, J. Bot. 76 (1938) 179; Hattink, Reinwardtia 9 (1974) 17, f. 3; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 23; Rudd in Fl. Ceylon 7 (1991) 48. — *Guilandina bonduc* L., Sp. Pl. (1753) 381, not of later ed. — Lectotype (Dandy & Exell 1938): *Herb. Hermann* 3, fol. 35 (BM); syntype: *Herb. Hermann* 2, fol. 17 (BM), Ceylon.

Caesalpinia sogerensis Baker f., J. Bot. 61, Suppl. (1923) 12. — Type: *Forbes* 112 (BM holo; L, P), New Guinea.

Liana up to 15 m. Branchlets usually armed with straight or recurved prickles (1–10 mm). *Stipules* subpersistent, pinnately or 3–5-lobed, lobes ovate, c. 5–20 mm long. *Leaves*: rachis 15–80 cm long; pinnae 6–11 pairs, 8–20 cm long, rachis sometimes prolonged to 3 mm. *Leaflets* opposite to subopposite, 6–9(–12) pairs per pinna, petiolulate (c. 1 mm), ovate- or elliptic-oblong, 1–6.5 by 0.5–3 cm, base rounded, apex rounded to acute, rarely acuminate, mucronate. *Inflorescences* supra-axillary and terminal, racemose or paniculate, 30–60 cm long, the rachis densely hairy; bracts lanceolate, 8–15 by c. 1 mm; pedicels 2–6 mm, articulated 0.5–1 mm below the flower. *Flowers* unisexual, buds ovoid, pubescent. *Hypanthium* c. 1 mm deep and 3 mm wide. *Sepals* 7–10 by 2–3 mm. *Petals* 7–10 by 2–3 mm, clawed (claw c. 3 mm long). *Stamens*: filaments 6–10 mm; anthers c. 1.25 mm long; staminodes in female flowers c. 6 mm. *Pistil* hairy; ovary c. 3 by 2 mm, densely set with c. 0.5 mm long spines, 2-ovuled; shortly stiped (c. 1 mm); style c. 3 mm, hairy; stigma ciliate; sterile pistil in male flowers rudimentary, c. 1 mm long, hairy. *Pods* 6.5–9 by 3.5–4.5 cm, base acute, apex rounded with style-remnant to 8 mm long, dehiscent, hairy, more or less densely set with 5–10 mm long hairy spines; pedicels 0.5–1.5 cm. *Seeds* 1 or 2, ovoid to globular, 15–20 mm long, smooth, grey, with parallel lines concentric with the hilum.

Distribution — Pantropic. In *Malesia* all over, but distinctly scarce in the rain forest areas in Sumatra, Borneo, the Philippines and western New Guinea.

Habitat — Often found in coastal regions, also occurring inland, secondary forests, in eastern *Malesia* up to c. 850 m altitude.

Ecology — Flowers and fruits often occurring together without periodicity.

3. *Caesalpinia coriaria* (Jacq.) Willd.

Caesalpinia coriaria (Jacq.) Willd., Sp. Pl., ed. 4, 2 (1799) 532; Backer & Bakh. f., Fl. Java 1 (1964) 544; Hattink, Reinwardtia (1974) 15; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 23, pl.

6/12, 13; in Fl. Thailand 4 (1984) 62, f. 19/12, 13; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 23; Rudd in Fl. Ceylon 7 (1991) 46. — *Poinciana coriaria* Jacq., Select. Stirp. Amer. Hist. (1763) t. 175, f. 36. — Type: ex illust.

Small tree or shrub, unarmed. *Stipules* minute, subulate. *Leaves* often imparipinnate, with 4–8 pairs of pinnae, often with additional terminal one. *Leaflets* 15–28 pairs per pinna, subsessile, oblong, 4–9 by 1–3.5 mm, rounded to truncate at the apex, obliquely subcordate at the base, glabrous. *Flowers* fragrant, in terminal and axillary, short, almost sessile condensed racemes, 2–6 cm long; pedicels 2–4 mm. *Hypanthium* 1–2 mm deep. *Sepals* 3–4 mm long. *Petals* yellow or cream, 3–6 mm long. *Pods* oblong to ovate, 3–6 by 1.5–3 cm, inflated, often becoming twisted or contorted, 1–10-seeded; valves black, thick, becoming fibrous-pulpy.

Distribution — Antilles, Mexico, S America and introduced into U.S.A. and Old World tropics.

Uses — Cultivated as an ornamental. The pods are rich in tannin and are (were?) used in the tanning industry ('divi-divi'). See Boonkerd c.s. in Lemmens & Wulijarni-Soetjpto (eds.), Pl. Res. SE Asia (PROSEA Handb.) 3, Dye and tannin-producing plants (1991) 57.

4. *Caesalpinia crista* L.

Caesalpinia crista L., Sp. Pl. (1753) 380, p.p., excl. syn. Pluk. & Breyn.; Backer & Bakh. f., Fl. Java 1 (1964) 545; Hattink, Reinwardtia 9 (1974) 20, f. 4/3; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 33, pl. 4/1–7; in Fl. Thailand 4 (1984) 70, f. 17/1–7; Rudd in Fl. Ceylon 7 (1991) 50. — Lectotype (Dandy & Exell 1938): *Herb. Hermann vol. 1, fol. 68* (BM), Ceylon.

Guilandina nuga L., Sp. Pl., ed. 2 (1762) 546. — *Caesalpinia nuga* (L.) Ait., Hort. Kew., ed. 2, 3 (1811) 32; Merr., Philipp. J. Sc., Bot. 5 (1910) 54; Interpr. Rumph. (1917) 261. — Type: *Nugae silvarum* Rumph., *Herb. Amb.* 5 (1747) t. 50, from Ambon.

Caesalpinia laevigata Perr., Mém. Soc. Linn. Paris 3 (1824) 104. — Type: *Perrottet s.n.*, Philippines.

Liana up to 15 m, glabrous in all vegetative parts; branchlets more or less armed with recurved prickles. *Stipules* minute, triangular, c. 1 mm long, caducous. *Leaves*: rachis 10–30 cm; pinnae 2–4 (or 5) pairs, 2.5–8(–12) cm. *Leaflets* opposite, 1–3(–5) pairs, petiolulate (2–4 mm), ovate to lanceolate, 2–10 by 1–5 cm, base acute, subequal, apex acute to obtuse, sometimes acuminate or rounded, margins curved, nerves prominent. *Inflorescences* axillary and terminal, paniculate, 20–40 cm long, the rachis shortly hairy when young; bracts c. 1 mm long; pedicels 7–15 mm, articulated c. 1 mm below flower. Flower buds glabrous. *Hypanthium* oblique, c. 2 mm deep and 5 mm wide. *Sepals* 6–8 by 2–4 mm, *Petals* 5–10 by 4–5 mm, clawed (claw up to 5 mm long). *Filaments* c. 10 mm; anthers c. 1.5 by 1 mm. *Pistil* c. 12 mm long, hairy or glabrous; ovary 2–3 by 2 mm, 1- or 2- (or 3-)ovuled; style c. 10 mm; stigma somewhat wider than the style, ciliate. *Pods* (stipitate 2–6 mm above the hypanthium), subelliptic or rhombic in outline, 4–7 by 2.5–3.5 cm, indehiscent, base cuneate, apex obtuse or acute, beaked. *Seeds* 1 (or 2), orbicular, ovoid to reniform in outline, flat, 2–2.5 by 1.5–2 by 0.5–1 cm, black.

Distribution — Coastal parts of SE Asia, from India through Malesia to Ryukyu Is., Australia (Queensland), Palau Is. and New Caledonia. All over *Malesia* except E Sumatra and E Borneo.

Habitat & Ecology — Riverbanks, on sandy beaches, in and behind the sandy parts of mangroves, on chalk rocks and limestone; at low altitude, rarely up to 350 m. No periodicity for flowering or fruiting.

5. *Caesalpinia cucullata* Roxb.

Caesalpinia cucullata Roxb. [Hort. Beng. (1814) 32, nom. nud.; Wall., Cat. (1831) 5828, nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 358; Hattink, Reinwardtia 9 (1974) 22; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1983) 52, pl. 8/12–15; in Fl. Thailand 4 (1984) 82, f. 21/5–8. — *Mezoneuron cucullatum* (Roxb.) Wight & Arn., Prod. Fl. Ind. Orient. (1834) 283. — Type: W. Carey s.n., India (Delta of the Ganges), cult. in the Botanic Garden at Calcutta.

Mezoneuron macrophyllum Blume ex Miq., Fl. Ind. Bat. 1, 1 (1855) 104; Koord., Exk. Fl. Java 2 (1912) 372. — Type: Blume [2100?] (L), Java.

Liana up to 20 m, all parts glabrous; branches armed with recurved prickles 5–10 mm long. *Stipules* absent. *Leaves*: rachis 10–40 cm long; pinnae 3–6 pairs, 10–20 cm long; *Leaflets* (sub)opposite, 3–6 pairs per pinna, petiolulate (2–4 mm), coriaceous, ovate, 5–12 by 2.5–6.5 cm, base acute to rounded, unequal to subequal, apex acuminate. *In-florescences* axillary and terminal, paniculate, 20–50 cm long, often from old stems; bracts absent; pedicels c. 8 mm, articulated in the middle or at c. 1/3 from the top. Flower buds globose. *Hypanthium* 2 mm deep and 6–8 mm wide. *Sepals* 5–12 by 3–4 mm. *Petals*: standard 6–8 by 10–12 mm, bilobed to about half the length, not clawed; the others suborbicular to ovate, 5.5–8.5 by 4–6 mm, slightly clawed. *Stamens* far exserted; filaments 20–25 mm; anthers c. 1.5 mm long. *Pistil* glabrous or short-silky, 1–2 mm stiped; ovary 5 by 1 mm, 1- (or 2-)ovuled; style 20–30 mm, curved upwards, stigma oblique, c. 0.5 mm in diam., glabrous. *Pods*: hypanthium persistent, c. 2 mm deep and 8–10 mm wide; the pod proper stipitate, 2–4 mm above the hypanthium, oblong-lanceolate, 7–11 by 2.5–3 cm (incl. 0.5 cm wide wing), shining, dark brown, base rounded, apex acuminate, often hooked, 1- (or 2-)seeded. *Seeds* orbicular, flat, c. 1 cm in diam., shining brown.

Distribution — India, China, Vietnam, Thailand; in *Malesia*: N & W Sumatra, Malay Peninsula, Borneo (Kalimantan: Banjarmasin), Java, Philippines (Luzon, Mindanao), Lesser Sunda Islands (Bali).

Habitat & Ecology — In forests, forest fringes and scrubland, up to 1500 m altitude. Fl. April–Oct.

6. *Caesalpinia decapetala* (Roth) Alston

Caesalpinia decapetala (Roth) Alston, Fl. Ceyl., Suppl. (1931) 89; Baeker & Bakh. f., Fl. Java 1 (1964) 545; Hattink, Reinwardtia 9 (1974) 24; J.E. Vidal in Fl. Camb., Laos & Vietnam 13 (1980) 28, pl. 3/1–7; in Fl. Thailand 4 (1984) 67, f. 16/1–7; Rudd in Fl. Ceylon 2 (1991) 51. — *Reichardia* ? *decapetala* Roth, Nov. Pl. Sp. (1821) 212. — Type: Heyne s.n. (K iso), India.

Caesalpinia sepiaria Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 360; Miq., Fl. Ind. Bat. 1, 1 (1855) 109; *ibid.*, Suppl. (1860) 108; Merr., Philipp. J. Sc., Bot. 5 (1910) 55, 371; Ridley, Fl. Malay Penins. 1 (1922) 650 — Types: Roxburgh s.n. (BM ?holo); Wallich 5834A (K iso or syn), India.

Caesalpinia benguetensis Elmer, Leaflet. Philipp. Bot. 1 (1907) 226. — *Mezoneuron benguetense* (Elmer) Elmer, op. cit. 362. — Type: *Elmer 8720* (BO, K, L), Luzon.

Caesalpinia ferox Hassk., Pl. Jav. Rar. (1848) 400. — Type (Hattink 1974): probably a living plant in Hort. Bog.

Liana or *shrub*, up to 25 m, young parts densely brown hairy, glabrescent; branchlets armed with recurved prickles (to 5 mm long). *Stipules* subsistent, obliquely ovate-semicordate, 8–13 by 4–7 mm, acuminate, hairy. *Leaves*: rachis 7–38 cm, hairy; pinnae 2.5–7 cm long, 3–10 pairs, hairy. *Leaflets* opposite, 5–12 pairs per pinna, shortly petiolulate (0.5–1 mm), membranous, elliptic-oblong, 12–22 by 4–11 mm, base rounded, apex truncate to retuse, shortly appressed hairy, rarely glabrous. *Inflorescences* axillary and terminal, racemose, 15–32 cm long, the rachis hairy; bracts ovate to lanceolate, 4–8 by 1–2.5 mm, pubescent; pedicels 15–30(–35) mm, pubescent, articulated 1–3 mm below the apex. Flower buds ovoid, hairy. *Hypanthium* 2 mm deep and 5–10 mm wide; *Sepals* 6–10 by 3–4 mm. *Petals* 6.5–13 by 4–8 mm, clawed (claw up to 6 mm). *Stamens* exserted; filaments 10–15 mm; anthers 1.5–2 mm, glabrous. *Pistil* c. 17 mm long; ovary 4–5 by 1–1.5 mm, hairy or glabrous, 8–10-ovuled; style 8–9 mm, glabrous; stigma c. 0.75 mm in diam. *Pods* (pedicels 20–40 mm), oblong, 6.5–11 by 2.25–3 cm, ligneous, dehiscent, sometimes with a longitudinal wing (up to 3 mm wide), base rounded, apex rounded, beaked, often prominently veined, exocarp and endocarp easily to be separated, 4–9-seeded. *Seeds* ellipsoid 8–12 by 6–8 mm, black, dull.

Distribution — India, Burma, Sri Lanka, China, Japan, and Pacific Islands (Tahiti and Oahu, indigenous?), also cultivated in other tropical countries and then run wild. In *Malesia*: Sumatra (northern half), Malay Peninsula (Penang I.), Java, Philippines (Luzon), SW Celebes, Lesser Sunda Islands (Lombok, Flores, Timor).

Habitat & Ecology — Open grasslands, scrubland, forest fringes and edges of belukar on mountains between 1000 and 1700 m (up to 2000 m in Nepal), at low altitudes in some extra-Malesian regions. In Malesia also cultivated at low altitude and then run wild. Seems to prefer a dry soil.

Uses — Used as impenetrable hedges [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 397]. Pods are (were?) used for tanning [See Boonkerd c.s. in Lemmens & Wulijarni-Soetjipto (eds.), Pl. Res. SE Asia (PROSEA Handb.) 3, Dye and tannin-producing plants (1991) 57].

7. *Caesalpinia digyna* Rottl.

Caesalpinia digyna Rottl., Ges. Naturf. Fr. Berl. Neue Schr. 4 (1803) 200, t. 3; Ridley, Fl. Malay Penins. 1 (1922) 651; Backer & Bakh. f., Fl. Java 1 (1964) 546; Hattink, Reinwardtia 9 (1974) 28, f. 4/6; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 41, pl. 6/1–8; in Fl. Thailand 4 (1984) 75, f. 19/1–8; Rudd in Fl. Ceylon 7 (1991) 52. — Type: *Rottler s.n.* (B holo; K), S India.

Caesalpinia gracilis Miq., Fl. Ind. Bat. 1, 1 (1855) 110. — Type: *Horsfield 138* (K holo; BM), Java.

Liana, scandent *shrub*, or small *tree*, up to 10 m, young parts densely rusty-brown hairy; branchlets armed with recurved prickles (4–5 mm long). *Stipules* subulate, to 3 mm long, slightly hairy, caducous. *Leaves*: rachis 17–23 cm; pinnae 8–13 pairs, 4–5

cm, unarmed. *Leaflets* opposite, 7–12 pairs per pinna, subsessile, membranous, oblong or ovate-oblong, 5–11 by 2.5–4.5 mm, appressed short-hairy on both surfaces, base oblique-truncate, apex truncate or notched, margins parallel, lateral nerves obscure. *Inflorescences* axillary and terminal, paniculate, 30–40 cm long, the rachis glabrous or hairy, with a few prickles in the basal part; bracts somewhat boat-shaped, 4 by 0.4 mm, hairy; pedicels spreading, slender, 15–25 mm, glabrous or with a few hairs, articulated at the base. Flower buds glabrous. *Hypanthium* 1–2 mm deep and 6–7 mm wide. *Sepals* 3–8 by 2–5 mm. *Petals* 5–8 by 3–8 mm, shortly clawed (claw up to 2 mm long). *Stamens* slightly exserted; filaments c. 12 mm; anthers 1.5 mm, glabrous or with a few hairs. *Ovary* 3–4 mm long, glabrous or silky-hairy along the sutures, 2–4-ovuled; style 6–8 mm, glabrous; stigma 0.3 mm in diam., short-hairy along the margin. *Pods* (with hypanthium persistent, 1–2 mm deep and 7 mm wide) indehiscent, elliptic-oblong, 3–5 by 2.5–2 cm, glabrous, base rounded, apex obtuse, short-beaked, often constricted between the seeds, 1–3- (or 4-)seeded. *Seeds* subglobose, 10–12 mm in diam, dark brown.

Distribution — India, Nepal, Sri Lanka, Burma, Laos, Cambodia, Vietnam, Thailand. In *Malesia*: Sumatra (Palembang), NW Malay Peninsula, Java (C and E, also Madura and Kangean Is.), Lesser Sunda Islands (Bali).

Habitat & Ecology — Dry plains or hills, savannahs, scrubland, forest fringes, up to 250 m altitude. Periodicity for flowering and fruiting not found.

Uses — The pods are rich in tannins and are used for tanning. See Boonkerd c.s. in Lemmens & Wulijarni-Soetjipto (eds.), *Pl. Res. SE Asia (PROSEA Handb.)* 3, Dye and tannin-producing plants (1991) 57. The seeds appear nutritious [Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 387].

8. *Caesalpinia enneaphylla* Roxb.

Caesalpinia enneaphylla Roxb. [Hort. Beng. (1814) 32, nom. nud.], *Fl. Ind.*, ed. Carey, 2 (1832) 363; Hattink, *Reinwardtia* 9 (1974) 30, f. 4/7; J.E. Vidal in *Fl. Thailand* 4 (1984) 77, f. 20/6, 7. — *Mezoneuron enneaphyllum* (Roxb.) Wight & Arn. ex Benth. in *Miq.*, *Pl. Jungh.* (1852) 258; Backer & Bakh. f., *Fl. Java* 1 (1964) 547. — Type: Roxburgh's drawing no. 1425 (K).

Shrub or climber, up to 15 m; branchlets sparsely armed. *Stipules* scale-like, c. 0.5 mm long, 1 mm wide. *Leaves*: rachis 20–40 cm; pinnae 8–12 pairs, 3–8 cm, shortly hairy to glabrous. *Leaflets* opposite, 8–12 pairs per pinna, petiolulate (0.5–1 mm), membranous, elliptic-oblong, 9–18 by 5–7 mm; base and apex rounded, margins parallel, glabrous. *Inflorescences* axillary and terminal, paniculate, 25–40 cm long, hairy to glabrous; bracts lanceolate, 1–2 by 0.25 mm, hairy; pedicels 10–20 mm, glabrous or sparsely hairy, articulated at 1–3 mm below the top. Flower buds almost globose. *Hypanthium* c. 2 mm deep and 4–6 mm wide. *Sepals* 4–6 by 2–4 mm, ciliate. *Petals*: standard with claw 3 by 1 mm, prolonged into a ligule c. 1 mm long with a bilobed apex, the limb reflexed, suborbicular, 4–5 mm in diam.; other 4 petals with claw 1 by 1 mm, ciliate, the limb suborbicular, c. 5 mm in diam. *Stamens* exserted; filaments c. 10 mm; anthers 1.5–2 mm, glabrous. *Pistil* subsessile, glabrous; ovary 4–5 by 1.5 mm, 4–6-

ovuled; style c. 6 mm, stigma c. 1 mm in diam., shortly ciliate. *Pods* (pedicels 15–20 mm) indehiscent, very thin, 8–12 by 2.5–4 cm (including the 7–10 mm wide wing), base cuneate, apex acute, 4–6-seeded. *Seeds* ellipsoid, flat, c. 7 by 5 by 2 mm, brown, smooth.

Distribution — India, China, Burma, Thailand, Vietnam, China; in *Malesia*: Java (Priangan, Rembang, Semarang), Celebes (Pangkadjene).

Habitat & Ecology — Forest fringes, c. 300 m altitude.

9. *Caesalpinia furfuracea* (Prain) Hattink

Caesalpinia furfuracea (Prain) Hattink, Reinwartia 9 (1974) 31, f. 1/8 & f. 5; J.E. Vidal in Fl. Thailand 4 (1984) 80, f. 21/1–4. — *Mezoneuron furfuraceum* Prain, J. As. Soc. Beng. 66, ii (1897) 471. — Type: Wallich Cat. no. 5835 (K holo; BM), Tenasserim.

Liana or straggling *shrub*; branchlets armed with recurved prickles (up to 5 mm long). *Stipules* persistent, scale-like, c. 0.5 by 1.5 mm. *Leaves*: rachis 25–30 cm long; pinnae 7 or 8 pairs, opposite or sometimes subopposite, 6–10 cm long, hairy. *Leaflets* opposite, 7–12 pairs per pinna, petiolulate (1 mm), membranous, oblong, 18–25 by 7–13 mm, base rounded or cuneate, apex rounded or retuse; glabrous or the costa below puberulous. *Inflorescences* axillary and terminal, racemose and paniculate, up to c. 40 cm long, the rachis brown-hairy, glabrescent; bracts 8–12 by c. 0.5 mm, hairy; pedicels 20–25 mm, usually articulated 0.5–1.5 mm below the apex. Flower buds glabrous. *Hypanthium* 2 mm deep and 7–8 mm wide. *Sepals* 8–15 by 4–6 mm, mostly ciliate. *Petals* glabrous: standard with claw 2–4(–6) mm long, limb arched, 3–4(–7) by 5–6 mm, reflexed, rounded at the apex; the other 4 petals with claw 2–4 mm long, the limb suborbicular, c. 15–20 mm in diam. *Stamens* exserted; filaments 15–20 mm, hairy to about the middle; anthers 4 mm, glabrous. *Ovary* 8 by 2 mm, glabrous, 4- or 5-ovuled; style c. 20 mm; stigma 1.5 mm in diam., shortly ciliate. *Pods* indehiscent, comparatively thin, 7–20 by 2.5–6 cm (incl. 10–17 mm wide wing), base cuneate, apex acute, often hooked, dull, 3- or 4-seeded. *Seeds* spaced, ellipsoid, c. 11 by 6 by 4 mm, brown, smooth, dull.

Distribution — Burma, Thailand, and in *Malesia*: Lesser Sunda Islands (Timor, Alor).

Ecology — Seemingly preferring a strong seasonal drought.

10. *Caesalpinia hymenocarpa* (Prain) Hattink

Caesalpinia hymenocarpa (Prain) Hattink, Reinwardtia 9 (1974) 35, f. 4/9; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 46, pl. 7/8–12; in Fl. Thailand 4 (1984) 79, f. 20/8–12. — *Mezoneuron hymenocarpum* Prain, J. As. Soc. Beng. 66, ii (1897) 233 (descr.), 472. — Type: Wallich Cat. no. 5832 (K holo; BM), Burma.

Liana or *shrub*; branchlets armed with recurved prickles. *Stipules* scale-like, c. 0.5 by 0.5–1 mm, appressed. *Leaves*: rachis 20–40 cm, shortly hairy; pinnae 6–10 pairs, 4–10 cm long, hairy, unarmed. *Leaflets* opposite or alternate, 10–18 per pinna, petiolulate (c. 1 mm), membranous, obovate or obovate-oblong, 11–28 by 5–16 mm, base subequal to unequal, apex rounded to retuse, margins parallel or curved, surfaces pubes-

cent or glabrous. *Inflorescences* axillary and terminal, paniculate, 30–50 cm long, the rachis pubescent; pedicels 8–15 mm, articulated 1–4 mm below the top. Flower buds pubescent. *Hypanthium* c. 1 mm deep and 6 mm wide. *Sepals*: lowest one deeply cucullate, 6–10 by 3.5–5 mm, ciliate. *Petals*: standard with claw 3–4 mm long, prolonged into a ligule (c. 1 mm long) with a bilobed or erose apex, margins hairy, limb reniform to orbicular, 3–4 by 4–6 mm, reflexed; other petals with claw c. 0.5 by 1 mm, hairy or glabrous, the limb suborbicular to reniform, 7–10 by 10–11 mm. *Stamens* exserted; filaments 7–17 mm; anthers 2.5 mm long, glabrous. *Pistil* glabrous; ovary 5 by 1 mm, 4–6-ovuled; style c. 12 mm, stigma 1 mm in diam., shortly ciliate. *Pods* (up to 0.5 cm stiped) thin, indehiscent, 6–15 by 2–3(–4) cm (incl. the 0.6–0.8 mm wide longitudinal wing), base cuneate, apex sometimes rounded, normally hooked, dull to shining, weakly reticulate, (1–)3–6-seeded. *Seeds* ellipsoid in outline, flat, 5–10 by 3–5 by 1 mm, dull.

Distribution — Sri Lanka, India, Burma, Laos, Cambodia, China, Thailand; in *Malesia*: Java (Jakarta), Lesser Sunda Islands (Sumbawa, Flores, Alor, Timor, Tanimbar).

Habitat & Ecology — Hill jungle, monsoon forest, riverbanks, up to 850 m altitude.

11. *Caesalpinia latisiliqua* (Cav.) Hattink

Caesalpinia latisiliqua (Cav.) Hattink, Reinwardtia 9 (1973) 37, f. 4/10, 6; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 50, pl. 8/8–11. — *Bauhinia* ? *latisiliqua* Cav., Ic. 5 (1799) 5, t. 408. — *Mezoneuron latisiliquum* (Cav.) Merr., Philipp. J. Sc., Bot. 4 (1909) 268; Sp. Blanc. (1918) 176; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 19. — Type: Cavanilles' plate excl. bauhinioid leaves, from the Philippines (Luzon).

Caesalpinia torquata Blanco, Fl. Filip. (1837) 336. — Type: lost.

Mezoneuron glabrum auct. non Desf.: Fern.-Vill., Nov. App. (1880) 70.

Mezoneuron rubrum Merr., Publ. Govt. Lab. Philip. 6 (1904) 7. — Type: Merrill 805 (PNH holo lost; K, US), Palawan.

Mezoneuron platycarpum Merr., Philipp. J. Sc., Bot. 11 (1916) 85. — Type: Hose 70 (BM, K, L, PNH), Sarawak.

Mezoneuron cabadbarensense Elmer, Leaflet. Philipp. Bot. 10 (1939) 3757. — Type: Elmer 13386 (BM, BO, GH, K, L, P, PNH, U), Mindanao.

Liana or small *tree*, up to 20 m; branchlets unarmed or with a few prickles. *Stipules* triangular, c. 2 mm long. *Leaves*: rachis 20–40 cm; pinnae 4–8 pairs, 7–13 cm. *Leaflets* alternate to subopposite, sometimes some of them opposite, 6–8 pairs per pinna, petiolulate (1–4 mm), membranous to coriaceous, oblong or obovate, 1.5–7 by 0.75–5 cm; base unequal to subequal, truncate, obtuse, or cuneate; apex rounded, truncate, or retuse; glabrous or appressed shortly hairy. *Inflorescences* axillary and terminal, paniculate, 30–100 cm long, the rachis unarmed; pedicels 10–20 mm, articulated at the base. *Flowers* pubescent or glabrous. *Hypanthium* 3–5 mm deep and 7–12 mm wide. *Sepals*: lowest one twice as long as the others, 7–15 by 6–8 mm. *Petals*: standard arched, bilobed to about half of its length, 8–12(–19) by 6–10(–14) mm, 1–2 mm wide at the base; the other petals 2–6 by 1.5–3 mm, shortly clawed or sessile, often ciliate. *Stamens* far exserted; filaments c. 14(–22) mm; anthers 1–2 mm. *Pistil* pubescent or glabrous; ovary c. 5 by 1 mm, flat, 6–13-ovuled; style c. 8 mm, stigma oblique, hairy along the margin.

Pods (pedicels 15–31 mm) 10–16 by 3–5 cm (incl. 10–15 mm wide wing at the upper side), indehiscent; base cuneate; apex variable, 6–9(–13)-seeded. *Seeds* ellipsoid, 9–12 by 6–7 mm, flat, brown, dull.

Distribution — Vietnam; in *Malesia*: Borneo (Brunei, Sarawak, Kalimantan), Philippines (scattered), Celebes (N, C & SE), Papua New Guinea (Morobe Prov.).

Habitat & Ecology — Rocks on sunny hot dry slopes, riverbanks and roadsides, primary forest and forest fringes, from 100 to 1500 m altitude.

12. *Caesalpinia major* (Medik.) Dandy & Exell

Caesalpinia major (Medik.) Dandy & Exell, J. Bot. 76 (1938) 180; Fosberg, Taxon 22 (1873) 162; Hattink, Reinwardtia 9 (1974) 39; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 26; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 38, pl. 5/9–12; in Fl. Thailand 4 (1984) 74, f. 18/9–12; Rudd in Fl. Ceylon 7 (1991) 49. — *Bonduc majus* Medik., Theod. Spec. (1786) 43, t. 3 upper part, excl. syn. *Guilandina bonduc* L. — *Caesalpinia globulorum* Bakh. f. & P. Royen, Blumea 12 (1963) 62; Backer & Bakh. f., Fl. Java 1 (1964) 545. — Type: *Frutex globulorum* Rumph., Herb. Amb. 5 (1747) 89, t. 48, from Moluccan Islands.

Caesalpinia glabra auct. non (P. Mill.) Merr.: Merr., Philipp. J. Sc., Bot. 5 (1910) 54.

Liana up to 15 m high; branchlets armed with prickles (0.5–3 mm long). *Stipules* subulate, 1–3 mm long, caducous. *Leaves*: petiole and rachis up to 75 cm long; pinnae 3–8 pairs, hairy or glabrous. *Leaflets* 3–7 pairs per pinna, petiolulate (c. 1 mm), membranous to subcoriaceous, elliptic or elliptic-oblong, 3–9 by 1.5–5 cm; acute to rounded at the base; apex acute to acuminate, rarely rounded. *Inflorescences* supra-axillary, racemose, sometimes paniculate, 10–50 cm long, the rachis densely hairy, glabrescent; bracts lanceolate, c. 5 mm; pedicels 6–12 mm, articulated below the top. *Flowers* unisexual. *Hypanthium* c. 1 mm deep and 3 mm wide. *Sepals* almost equal, c. 7 by 2 mm. *Petals* yellow, 4–7 by 2–3 mm, clawed (claw up to 3 mm long). *Stamens*: filaments in male flowers 6–7 mm, anthers c. 1.25 mm; in female flowers c. 5 mm. *Pistil* in female flowers c. 7 mm long; ovary c. 4–5 mm long, hairy and densely spiny (c. 0.5 mm), 4-ovuled; style c. 3 mm, hairy, stigma ciliate; pistil in male flowers rudimentary, c. 1 mm long, hairy. *Pods* 5–13 by 4–6 cm, base acute, apex rounded; hairy together with more or less densely hairy bristles (5–10 mm), 2–4-seeded. *Seeds* (sub)globular, 15–25 mm in diam., smooth.

Distribution — America (SE United States, Caribbean Is., Guyana), Madagascar, SE Asia from India to the Ryukyu Is., Pacific Is. (Micronesia, Sandwich Is., Tonga); in *Malesia*: all parts, except the major rain forests of Sumatra, Borneo, the Philippines, Celebes, and New Guinea.

Habitat & Ecology — Beaches, sandy areas, thickets, primary forests and forest fringes, dense jungles, up to 1000 m altitude (up to 1400 m in New Guinea). Periodicity for flowering and fruiting not found.

13. *Caesalpinia mindorensis* (Merr.) Hattink

Caesalpinia mindorensis (Merr.) Hattink, Reinwardtia 9 (1974) 41, f. 4/12, 8e–h. — *Mezoneuron mindorensis* Merr., Philipp. J. Sc., Bot. 3 (1908) 232; Enum. Philipp. Flow. Pl. 2 (1923) 268. — Type: *FB* 5383, Mindoro.

Mezoneuron mindorense Merr. var. *inermis* Merr., Philipp. J. Sc., Bot. 3 (1908) 232; Enum. Philipp. Flow. Pl. 2 (1923) 268. — Type: *BS 1514* (iso BO, GH, K, NY, US), Mindoro.

Liana; branchlets glabrous, more or less armed with prickles. *Stipules* scale-like, c. 0.5 mm long, 1–2 mm wide, appressed. *Leaves*: rachis 20–35 cm, glabrous, unarmed or with prickles; pinnae 10–13 pairs, 5–18 cm long, shortly hairy, unarmed. *Leaflets* petiolulate (0.5–1 mm), 16–24 pairs per pinna, oblong, rarely obovate, 8–22 by 4–8 mm; base rounded to cordate; apex retuse; glabrous or hairy at the base beneath. *Inflorescences* supra-axillary and terminal, serial or racemose, 10–30 cm long, or paniculate 20–50 cm long, the rachis pubescent; bracts boat-shaped, 4–5 by 1 mm (incl. the 2–3 mm bristle), hairy; pedicels 8–15 mm, pubescent, articulated 1–2 mm below the top. *Flowers* yellow, pubescent. *Hypanthium* 2 mm deep and 6 mm wide. *Sepals* 6–8 by 3–5 mm, ciliate. *Petals* 7–10 by 4–10 mm, clawed (claw up to 4 mm long). *Stamens* exserted; filaments 11–13 mm; anthers 1.5 mm long, glabrous. *Pistil* glabrous; ovary 3–4 mm long, 1- or 2-ovuled; style 6–12 mm, stigma 1 mm in diam., shortly ciliate. *Pods* (pedicels 20–30 mm), fleshy, indehiscent, 6–9 by 2–3 cm (incl. the 5–8 mm wide longitudinal wing along the upper side), base attenuate, top rounded and often hooked, 1-seeded. *Seeds* orbicular, flat, 7 mm in diam., dull.

Distribution — *Malesia*: Philippines (Mindoro, Biliran, Mindanao).

Habitat — Secondary forests, edge of swamps, thickets, at low altitudes.

14. *Caesalpinia oppositifolia* Hattink

Caesalpinia oppositifolia Hattink, Reinwardtia 9 (1974) 43, f. 9. — Type: *Singh SAN 24026* (L holo; K, SAN), Sabah, Mt Kinabalu.

Liana; branchlets unarmed or with prickles. *Stipules* suborbicular, persistent, up to 35 by 45 mm. *Leaves* opposite; rachis 25–50 cm, shortly pubescent or glabrous; pinnae 4–6 pairs. *Leaflets* opposite or subopposite, petiolulate (c. 1 mm), 5–8 pairs per pinna, elliptic- or ovate-oblong, 4–10 by 1.5–4.5 cm, base unequal, apex acute to obtuse, emarginate, glabrous. *Inflorescences* axillary and terminal, racemose, up to 40 cm long, rachis pubescent, glabrescent; bracts boat-shaped, c. 3 by 1 mm, caducous; pedicels 5–10 mm, articulated c. 0.5 mm from the base, pubescent. *Flowers* pubescent. *Hypanthium* c. 2 mm deep and 3 mm wide. *Sepals* c. 3 by 1.5 mm. *Petals* spatulate, 4–5 by 2 mm, very shortly clawed. *Filaments* c. 5 mm; anthers c. 0.75 mm long, glabrous. *Ovary* c. 2 mm long, 2-ovuled; style 1–2 mm, hairy at the lower half, stigma ciliate. *Pods* (detached) c. 9 by 4 cm, dehiscent, base rounded, apex truncate, beaked at the upper angle. *Seeds* 2, ovoid in outline, flat, c. 27 by 3 mm, black.

Distribution — *Malesia*: Sabah (Sandakan region and Mt Kinabalu).

Habitat — Riverbanks and open spaces in primary forests, up to 600 m altitude.

15. *Caesalpinia parviflora* Prain

Caesalpinia parviflora Prain, J. As. Soc. Beng. 66, ii (1897) 230 (descr.), 470, incl. var. *typica*; Hattink, Reinwardtia 9 (1974) 45; J.E. Vidal in Fl. Thailand 4 (1984) 70, f. 17/8–13. — Lectotype (Hattink 1974): *Wray 1909* (CAL holo; K, SING), Malaya, Perak.

Caesalpinia parviflora Prain var. ?*stipularis* Prain, J. As. Soc. Beng. 66, ii (1922) 230 (descr.), 470. — *Caesalpinia stipularis* (Prain) Ridley (not the S American sp. of Benthams), Fl. Malay Penins. 1 (1922) 651. — Syntypes: Wray 3983, 3991, 4261 (SING), Malaya, Perak.

Caesalpinia minutiflora Elmer, Leaf. Philip. Bot. 5 (1913) 1803. — Type: Elmer 12969 (BM, K, L, P, PNH, U), Palawan.

Caesalpinia borneensis Merr., Pl. Elmer. Born. (1929) 104. — Type: Elmer 21449 (UC holo; A, BM, BO, K, L, NY, P, U, SING), Sabah.

Liana or small *tree*; branchlets with recurved prickles, hairy. *Stipules* lanceolate to broadly ovate-oblong, 8–20 by 3–11 mm, sessile, subsistent. *Leaves*: rachis 14–35 cm, hairy; pinnae 8–19 pairs. *Leaflets* opposite, 13–18 pairs per pinna, sessile, oblong, 7–26 by 2.5–9 mm; base obliquely truncate; apex retuse, sometimes truncate; both surfaces slightly shortly hairy or glabrous. *Inflorescences* supra-axillary and terminal, paniculate, up to 100 cm long, the rachis densely shortly hairy; bracts linear, lanceolate, or broadly ovate, (1.5–)5–6 by 0.25–1 mm; pedicels 4–11 mm, articulated c. 0.5 mm below the top. *Hypanthium* c. 1–2 mm deep and 3–5 mm wide. *Sepals* 2–7 by 1–3 mm. *Petals* oblong, 5–8 by 1.5–4 mm, clawed (claw up to 2 mm long). *Stamens* exerted; filaments 5–10 mm; anthers c. 0.5 mm long, glabrous. *Ovary* 2–4 by 1–1.5 mm, hairy, 2-ovuled; style 3–6 mm, hairy at the basal part; stigma obscure. *Pods* (pedicels 11–15 mm), obovoid, up to 10 by 3.5 cm, apex obtuse, base rounded, upper margin ending in a sharp beak, 1- or 2-seeded. *Seeds* orbicular, flat, up to 2 cm in diam., smooth.

Distribution — *Malesia*: Malay Peninsula (Perak, Selangor, Negri Sembilan), Borneo (Sabah), Philippines (Palawan).

Habitat — Primary forests and clearings at low altitudes.

16. *Caesalpinia pubescens* (Desf.) Hattink

Caesalpinia pubescens (Desf.) Hattink, Reinwardtia 9 (1974) 47, f. 4/15; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 44, pl. 7/1–5; in Fl. Thailand 4 (1984) 77, f. 20. — *Mezoneuron pubescens* Desf., Mém. Mus. Hist. Nat. Paris 4 (1818) 247, t. 11; Miq., Fl. Ind. Bat. 1, 1 (1855) 104; Merr., Philipp. J. Sc., Bot. 5 (1910) 56; Backer & Bakh. f., Fl. Java 1 (1964) 547. — Type: *Leschenault s.n.* (P), Java.

Mezoneuron glabrum Desf., Mém. Mus. Hist. Nat. Paris 4 (1818) 246, t. 10; Miq., Fl. Ind. Bat. 1, 1 (1855) 103. — Type: *Leschenault s.n.* (P holo; K), Timor.

Liana or scandent *shrub* (or tree ?), up to 10(–15) m; branchlets with few recurved prickles. *Stipules* acute, persistent, up to 2 by 0.5 mm, hairy. *Leaves*: rachis 20–60 cm; pinnae 9–15 pairs. *Leaflets* petiolulate (0.5–1 mm), 5–10 pairs per pinna, oblong or elliptic-oblong, 8–24 by 4–12 mm; apex truncate or retuse; base rounded, more or less asymmetric; shortly appressed hairy, sometimes almost glabrous. *Inflorescences* axillary and terminal, racemose, rachis pubescent; bracts lanceolate, 5–10(–20) by 2–3(–4) mm (incl. the acuminate apex), pubescent; pedicels 20–35 mm, pubescent, articulated c. 3 mm below the top. Flower buds almost globose, 7.5–10 mm in diam., pubescent. *Hypanthium* 2–4 mm deep and 7–8 mm wide. *Sepals* 7–16 by 3–7 mm, pubescent on both surfaces. *Petals*: standard with claw 3 by 0.5 mm, prolonged into a glabrous ligule,

limb reniform to broadly ovate, 4–5 by c. 10 mm, margins hairy; the other petals with claw very short, hairy, limb suborbicular, 10–20 mm in diam., sometimes ciliate. *Stamens* exserted; filaments 12–15 mm; anthers 2.5–3.5 mm long, glabrous. *Pistil* (sub)sessile, pubescent except the upper half of the style; ovary 5–8 by 2–3 mm, 4–7-ovuled; style 3–5 mm; stigma 0.5 mm wide, hairy on the margin. *Pods* indehiscent, 10–15 by 4–5(–6) cm (incl. the 8–12(–16) mm wide wing); 4–7-seeded. *Seeds* compactly arranged in the middle of the pod (number of seeds not countable from outside), ellipsoid in outline, 8–10 by 3–6 mm, brown, smooth.

Distribution — N Vietnam (coast of Annam), Thailand (Peninsula); in *Malesia*: Sumatra (Bangka), Java (all parts, also Madura and Kangean Is.), Philippines (C Luzon), Celebes (SW and Salajar), Lesser Sunda Islands (Bali, Lombok, Sumbawa, Flores, Timor, Wetar).

Habitat & Ecology — Monsoon forests, scrubland, savannahs, up to 700 m altitude. Prefers a seasonal drought and flowers at the end of the wet season.

17. *Caesalpinia pulcherrima* (L.) Swartz

Caesalpinia pulcherrima (L.) Swartz, *Observ. Bot.* (1791) 66; Hattink, *Reinwardtia* 9 (1974) 50; J.E. Vidal in *Fl. Camb., Laos & Vietnam* 18 (1980) 24, pl. 2/1–7; in *Fl. Thailand* 4 (1984) 65, f. 15/1–7; Rudd in *Fl. Ceylon* 7 (1991) 46. — *Poinciana pulcherrima* L., *Sp. Pl.* (1753) 380. — Syn-types: *Herb. Linn.* 529/1 (LINN); *Herb. Hermann* 4, fol. 50, 5; fol. 26; 436 (BM); *Herb. Hermann* fol. 96, 114, 116 & 117 (L), India.

Shrub or small *tree*, up to 5 m tall, glabrous; branchlets unarmed or with a few straight prickles. *Stipules* subulate, c. 2 mm long, caducous. *Leaves*: rachis 20–40 cm; pinnae 5–9 pairs, often with a small subulate stipel (c. 0.5 mm long) between the pair. *Leaflets* opposite, 6–12 pairs per pinna, petiolulate (1–2 mm), oblong or elliptic-oblong, 9–30 (–35) by 5–15(–23) mm; base unequal, rounded; apex rounded to retuse. *Inflorescences* axillary and terminal, racemose, sometimes paniculate, 20–50 cm long, rachis glabrous, rarely with a few straight prickles; bracts c. 5 by 0.5 mm; pedicels 70–100 mm, not articulated. *Hypanthium* c. 2 mm deep and 4 mm wide. *Sepals* 10–15 by 5–7 mm, ciliate. *Petals* yellow or flame-red, or red with a yellow margin, 10–25 by 6–8 mm, clawed (claw up to 15 mm long). *Stamens* very far exserted; filaments 55–75 mm; anthers 1.5–2.5 mm long, glabrous. *Pistil* about as long as the stamens; ovary 15–20 mm long, 8–12-ovuled; style 50–65 mm; stigma ciliate. *Pods* (pedicels 70–100 mm), 6–9 (–11) by 1.5–2 cm, dehiscent, septate, more or less woody, often widest at the rounded top, beaked, 8–10-seeded. *Seeds* slightly rectangular, 8–10 by 6–8 mm, black, dull.

Distribution — Originating in tropical America; widely distributed in the tropics of the world.

Uses — Cultivated as an ornamental throughout Malesia, naturalized in some regions. See K. Heyne, *Nutt. Pl. Indon.*, ed. 3 (1950) 752; Burkill, *Diet. Econ. Prod. Malay Penins.* (1935) 393.

18. *Caesalpinia sappan* L.

Caesalpinia sappan L., Sp. Pl. (1753) 381; Whitmore in Tree Fl. Malaya 1 (1972) 246; Hattink, Reinwardtia 9 (1974) 51, f. 4/17; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 26, pl. 2/8–14; in Fl. Thailand 4 (1984) 65, f. 15/8–14; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 27; Rudd in Fl. Ceylon 7 (1991) 52. — Type: *Herb. Hermann, vol. 4, fol. 31* (BM), Sri Lanka.

Small *tree* or *shrub*, up to 10 m tall; branchlets usually with recurved prickles, rarely unarmed. *Stipules* 3–4 mm, caducous. *Leaves*: rachis 25–40 cm; pinnae 9–14 pairs. *Leaflets* 10–20 pairs per pinna, opposite, sessile or subsessile, oblong, 10–25 by 3–11 mm; base obliquely truncate; apex retuse or rounded; glabrous or sparsely shortly hairy. *Inflorescences* supra-axillary and terminal, paniculate, 10–40 cm long; bracts 5–12 by 2–5 mm hairy, caducous; pedicels 15–20 mm, articulated 1–2 mm below the top. *Flower* yellow, glabrous, often punctate. *Hypanthium* c. 2 mm deep and 6–8 mm wide. *Sepals* ciliate, the lower one c. 10 by 4 mm, the others c. 7 by 4 mm. *Petals* 9–11.5 by 6–10 mm, clawed (claw up to 5 mm long). *Stamens* exserted; filaments c. 15 mm; anthers c. 1.5 mm long, glabrous. *Pistil* c. 18 mm long, pubescent; ovary c. 4 by 1.5 mm, 3–6-ovuled; style c. 14 mm; stigma c. 0.5 mm in diam., ciliate. *Pods* (pedicels up to 20 mm), oblong to asymmetrically elliptic, 6–10 by 3–4 cm; base rounded; apex truncate; beaked, 2–4-seeded. *Seeds* ellipsoid, 15–18 by 8–11 mm, black.

Distribution — Origin unknown. Cultivated in S & SE Asia, *Malesia*, Africa, and America. Sometimes escaped from cultivation.

Uses — The wood ('*sappanwood*') was a major world source of red dye till the end of the 19th century. See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 390; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 753; Zerrudo in Lemmens & Wulijarni-Soetjipto (eds.), Pl. Res. SE Asia (PROSEA Handb.) 3, Dye and tannin-producing plants (1991) 60.

19. *Caesalpinia scortechinii* (F. Muell.) Hattink

Caesalpinia scortechinii (F. Muell.) Hattink, Reinwardtia 9 (1974) 52, f. 4/18. — *Mezoneuron scortechinii* F. Muell. in Wing, South. Sc. Rec. (1882) 73; F.M. Bailey, Queensl. Fl. 2 (1900) 451, t. 15, f. 5–7; Merr. & L.M. Perry, J. Arnold Arbor. 23 (1942) 399; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 19. — Type: *Bidwill s.n.* (K), Queensland.

Liana or *shrub*; branchlets shortly pubescent or glabrous, with a few small, recurved prickles. *Stipules* c. 1 mm long, 2 mm wide, appressed, caducous. *Leaves*: rachis 13–25 cm; pinnae 5–8 pairs, unarmed. *Leaflets* alternate, petiolulate (c. 1 mm), 5–8 pairs per pinna, oblong, 15–30 by 7–16 mm, oblique at the base, rounded at the apex, glabrous or hairy. *Inflorescences* supra-axillary and terminal, paniculate, up to c. 30 cm long, rachis puberulous or glabrous; bracts subulate, c. 3 mm long, hairy; pedicels 3–5 mm, articulated c. 0.5 mm below the top. *Hypanthium* c. 1 mm deep and 4 mm wide, shortly hairy or glabrous. *Sepals* almost glabrous, 5–6 by 2 mm. *Petals* yellow, oblong, 4–6 by 2–3 mm, shortly clawed (claw up to 2 mm long); filaments c. 7 mm; anthers c. 1.5 mm long, villose. *Pistil* pubescent or glabrous, sometimes rudimentary;

ovary c. 2 mm long, 1- or 2-ovuled; style c. 6 mm, hairy in the lower part; stigma not wider than the style, ciliate. *Pods* obliquely rhomboid or broadly ellipsoid, 3–5 by 2–3 cm (incl. 1–6 mm wide wing at the upper side), base rounded to cuneate, apex rounded, black, prominently veined, 1-seeded. *Seeds* almost reniform in outline, flat, c. 18 by 15 mm.

Distribution — Australia (Queensland, New South Wales); in *Malesia*: Papua New Guinea (Western, Southern Highlands and Central Provinces).

Habitat & Ecology — Rain forests, secondary forests, riverbanks and along roads, up to 810 m altitude.

20. *Caesalpinia solomonensis* Hattink

Caesalpinia solomonensis Hattink, Reinwardtia 9 (1974) 54, f. 4/19, 7; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 29. — Type: *Maenu'u BSIP 6068* (L holotype; HON, K, LAE, SING, US), New Georgia.

Liana up to 12 m high, with glossy glabrous branchlets. *Stipules* wanting. *Leaves* glabrous; rachis 70–80 cm; pinnae 6 pairs, 15–21 cm long. *Leaflets* opposite or subopposite, c. 5 pairs per pinna, petiolulate (1–2 mm), oblong, 7.5–8.5 by 3–3.5 cm; base acute, apex acuminate; nerves prominent. *Flowers* not yet known. *Infructescences* supra-axillary, serial, racemose, 15–18 cm long, glabrescent; pedicel of the pod 6–10 mm, stipe (above the hypanthium) 7–10 mm. *Hypanthium* remnant 3–4 mm deep and 8 mm wide. *Pods* broadly ellipsoid, 10–12.5 by 7.5–8 cm, base oblique, acute, apex apiculate, smooth and flat, 2-seeded. *Seeds* suborbicular, 25–30 mm in diam., flat, brown, wrinkled.

Distribution — Solomon Islands (New Georgia), so far not yet found in *Malesia*.

Habitat — Well-drained secondary forest, at low altitude.

21. *Caesalpinia sumatrana* Roxb.

Caesalpinia sumatrana Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 366; Hattink, Reinwardtia 9 (1974) 55, f. 4/20. — *Mezoneuron sumatranum* (Roxb.) Wight & Arn. ex Miq., Fl. Ind. Bat. 1, 1 (1855) 105, and (1858) 1081; *ibid.*, Suppl. (1860) 108; Backer & Bakh. f., Fl. Java 1 (1964) 546; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 20, f. 2. — Type: *C. Campbell s.n.*, Sumatra.

Mezoneuron sulfureum Miq., Fl. Ind. Bat. 1, 1 (1855) 105. — Type: *Zollinger s.n.* (as 1002 in P) (U holotype; BM, K, P), Java.

Mezoneuron sumatranum (Roxb.) Wight & Arn. ex Miq. var. β Miq., Fl. Ind. Bat. 1, 1 (1858) 1081. — Type: *Teijsmann s.n.* (U holotype; K, L), Sumatra.

Mezoneuron koordersii Backer, Schoolfl. Java (1911) 396. — Type: *Koorders 34442* (BO holotype; L), Java.

Mezoneuron peekelii Harms, Bot. Jahrb. 55 (1917) 58. — Type: *Peekel 453*, New Ireland.

Liana to 20 m, glabrous in all parts except sometimes hairy on the leaflets; branchlets unarmed or sparsely armed with up to 5 mm long prickles. *Stipules* none or early caducous. *Leaves*: rachis 30–50 cm; pinnae 4–8 pairs, unarmed or sparsely armed with recurved prickles. *Leaflets* alternate, except at the top often an opposite pair, 7–12 per pinna.



Fig. 20. *Caesalpinia sumatrana* Roxb. Characteristic stem (10 cm diam.). Mt Sago, Sumatra (W. Meijer 3157). Photograph W. Meijer, 1955.

petiolulate (2–3 mm), oblong, 2.5–7 by 1.5–5.5 cm, base cuneate or truncate, apex retuse or rounded, rarely obtuse, glabrous, sometimes hairy beneath. *Inflorescences* supra-axillary and terminal, paniculate, 30–80(–100) cm long; bracts boat-shaped, c. 1 by 0.5 mm; pedicels 5–20 mm, articulated at the base. Flower buds oblong, glabrous. *Hypanthium* 3–7 mm deep and 4–8 mm wide. *Calyx-tube* red, 6–15 by 4–8 mm, at length circumscissile above the hypanthium and falling off with the corolla and stamens; calyx lobes half-orbicular, 2–10 mm long, often ciliate. *Petals* pink, more or less equal,

spathulate, 12–32 by 8–12 mm, clawed (claw 10–15 mm). *Stamens* pale pink with brown anthers, not or slightly exceeding the petals; the filaments 15–29 mm; anthers c. 1.5–3 mm long, glabrous. *Pistil* 12–30 mm long, glabrous; ovary 6–15 mm long, 2–4(–8)-ovuled; style 6–15 mm; stigma as wide as the style, ciliate. *Pods* dark wine-red, subsessile, oblong, 10–17 by 3–6 cm (incl. the 1–2 cm wide wing), cuneate at the base, rounded or hooked at the apex, smooth or slightly reticulate-nerved, 1–8-seeded. *Seeds* brown, flat, elliptic, c. 11 by 7 mm. — **Fig. 20.**

Distribution — India?, Solomon Islands (Guadalcanal); in *Malesia*: Sumatra (West-coast, Bengkulu), Malay Peninsula (most of the provinces), Borneo (Sabah), Java (W & E parts), New Guinea (Irian Jaya: Jayapura; Papua New Guinea: W Sepik, Morobe, Central Prov., Papuan Is., New Britain, New Ireland).

Habitat & Ecology — Lowland rain forest and secondary forest, forest fringes, along roads, usually at low altitudes, sometimes up to 1000 m.

22. *Caesalpinia tortuosa* Roxb.

Caesalpinia tortuosa Roxb. [Hort. Beng. (1814) 32, nom. nud.], Fl. Ind., ed. Carey, 2 (1832) 365; Hattink, Reinwardtia 9 (1974) 57. — Type: *Roxburgh s.n.* (K), 'Hort. Calc. e. Sumatra'.

Cinclidocarpus nitidus Zoll., Nat. Geneesk. Arch. Neërl. Indië 3 (1846) 82. — *Caesalpinia cinclidocarpa* Miq., Fl. Ind. Bat. 1, 1 (1855) 110; Backer & Bakh. f., Fl. Java 1 (1964) 546. — Type: Zollinger 3462 (L holo; A, BM, P), Java.

Caesalpinia acanthobotrya Miq., Fl. Ind. Bat., Suppl. (1860/61) 108 (nom.), 293 (descr.). — Type: Diepenhorst HB 2240 (U holo; BO), Sumatra.

Liana, shrub or small *tree*, up to 10 m tall; branchlets glabrous, with recurved prickles. *Stipules* absent. *Leaves*: rachis 30–45(–70) cm, hairy, pinnae 7–20 pairs, hairy, unarmed. *Leaflets* opposite, 12–30(–40) pairs per pinna, sessile, narrowly oblong or linear, 9–22 by 2–6 mm; base oblique, truncate; apex obtuse or rounded; glabrous or sparsely shortly hairy. *Inflorescences* (supra)axillary and terminal, often paniculate, 20–60 cm long, the rachis pubescent, with recurved prickles, sometimes unarmed; bracts 2 by 1 mm, hairy; pedicels 8–15 mm, hairy, articulated at the base. Flower buds glabrous or hairy in the basal part. *Hypanthium* 2 mm deep and 8 mm wide. *Sepals* 3–10 by 6–7 mm, usually ciliate. *Petals* 4–10 by 6–12 mm, clawed (claw up to 8 mm long). *Stamens* slightly exserted; filament 10–14 mm; woolly over about half their length; anthers 2.5–3 mm long, glabrous. *Pistil* subsessile, 10–16 mm long; ovary 3–4 mm long, hairy or glabrous, 4–5(–7)-ovuled; style 8–12 mm, glabrous or hairy only in the basal part; stigma c. 1 mm in diam. *Pods* indehiscent, often twisted, oblong, 3.5–9 by 2–3.5 cm; base rounded, apex obtuse, shortly beaked; glabrous, black when dried, 1–5(–7)-seeded. *Seeds* subglobose, c. 10 mm in diam.

Distribution — India (Assam), China (Hongkong), Burma; in *Malesia*: Sumatra (East- & Westcoast), Malay Peninsula (Johore, Penang I.), Singapore, Borneo (Kalimantan), Java (W & E regions).

Habitat & Ecology — Primary and secondary forests, forest fringes, along rivers; in Java often on limestone.

CASSIA

(K. Larsen & Ding Hou)

Cassia L., Sp. Pl. 1 (1753) 376; Gen. Pl., ed. 5 (1754) 178, p.p., excl. syn. *Senna* Tournef.; de Wit, Webbia 11 (1956) 198, p.p.; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 105; Mem. N.Y. Bot. Gard. 35 (1982) 4; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 17, excl. syn.; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 77; in Fl. Thailand 4 (1984) 102, p.p.; Rudd in Fl. Ceylon 7 (1991) 59, p.p., excl. syn. — Type species (Irwin & Barneby 1982): *Cassia fistula* L.

Trees or large *shrubs*. *Leaves* spirally arranged, often distichous, paripinnate; extrafloral nectaries not present. *Inflorescence* racemose, terminal on main shoots or on short side shoots; pedicels with 2 bracteoles at or shortly above the base. *Hypanthium* variable. *Calyx* 5-merous, sepals reflexed at anthesis. *Corolla* zygomorphic, 5-merous. *Androe-cium* zygomorphic, 10-merous, filaments of 3 abaxial, antesepalous stamens sigmoidally curved, usually longer than their anthers, dehiscent by slits; the remaining 7 filaments straight and short with anthers mostly dehiscing by basal pores. *Pods* elongate, cylindric or compressed, indehiscent. *Seeds* many, 1- or 2-seriate; funicle filiform.

Distribution — About 30 species, in tropical America, Africa, Asia, Malesia and Australia. In *Malesia* there are three introduced and only one indigenous species.

Habitat — In forests at low altitudes.

Note — In the present treatment we have followed the generic concept of Irwin & Barneby (l.c. 1981: 97–106), who through three decades have studied the tribe *Cassieae* of the New World and proposed a reorganization of the tribe. This has now been generally accepted even if it breaks with the most common arrangements in Floras and Herbaria. In the ‘neighbouring’ Floras, i.e. Flora of Thailand and Flore du Cambodge, du Laos et du Viêt-Nam, the genus *Cassia* has been treated in its wider sense. We have here, inconveniently, decided to follow the newer system, partly because it is widely accepted, e.g. by the ILDIS-database, partly because Irwin and Barneby have reevaluated and typified a number of widespread taxa in our region, and finally because the great majority of the species occurring in the Malesian region are introduced, cultivated or, in several cases, naturalized. In the genus *Cassia* only one species is indigenous, in *Senna* probably only 3 out of 17 treated here, and in *Chamaecrista* one or two only.

A number of taxa, occasionally recorded as in cultivation in *Malesia*, have not been included. See also page 565.

KEY TO THE SPECIES

- 1a. Inflorescence 15–40 cm long, lax. Flowers yellow. Pods 20–60 cm long, terete, glabrous, smooth **2. *C. fistula***
- b. Inflorescence up to 15 cm long. Flower pink-reddish **2**
- 2a. Inflorescence 10–25 cm; bracts early caducous before anthesis. Pods 3–5 cm in diam., coarsely rugose **3. *C. grandis***
- b. Inflorescence 3–15 cm; bracts persisting during anthesis. Pods 1–1.5 cm diam., smooth, glabrous or pubescent **3**

- 3a. Petals 3.5–4.5 cm; pods greyish or brownish velvety **1. *C. bakeriana***
 b. Petals up to 3.5 cm, usually smaller **4. *C. javanica***

1. *Cassia bakeriana* Craib

Cassia bakeriana Craib, Kew Bull. (1911) 45; de Wit, Webbia 11 (1956) 205; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 38 ('*bakerana*'); K. & S.S. Larsen in Fl. Thailand 4 (1984) 105. — Type: *Hosseus* 478 (K), Thailand.

Tree up to 10 m high; all young parts densely pubescent. *Leaves* with 5–7 pairs of leaflets; stipules narrow-lanceolate, pointed towards both ends, attached in the middle; petiole 2–4 cm long, light brownish pubescent as the 15–40 cm long rachis. *Leaflets* oblong to oblanceolate, 6–8 by 1.5–3 cm, rounded at both ends; apex with a small mucro, both sides more or less densely velvety hairy; petiolule 2 mm. *Racemes* lateral, 5–12 cm long, 1–few together; main axis yellowish pubescent; bracts lanceolate, apex long-pointed, hairy on both sides, 7–12 by 3 mm at base; bracteoles similar but only 1/3 the length. *Flowers* large (the largest flowers of any *Cassia* in the region), on a 6 cm long, thinly pubescent pedicel, more densely hairy in a ring just below the calyx. *Sepals* ovate-lanceolate with acute apex, 9–12 by 2–3 mm, hairy on both sides. *Petals* ovate lanceolate, pinkish, 3.5–4.5 by 1–2.5 cm, claw narrow, c. 5 mm long. *Stamens*: 3 long with filaments 3.5–5 cm, swollen in the middle, anthers 5 mm long, ovoid, opening by apical and basal slits; 4 with filaments half the length but with anthers nearly twice as long, also opening by slits; reduced stamens 3, small, with filaments 1–1.5 cm long and very small anthers. *Ovary* whitish pubescent, recurved, c. 4 cm long, on a 1–1.5 cm long stipe; stigma subapical, punctiform. *Pods* pendulous, terete, grey to brownish velvety pubescent, 30–40 by 1–1.5 cm diam. *Seeds* 30–40, separated by spongy septa.

Distribution — Endemic to Burma and Thailand. Introduced as ornamental in e.g. West Malaysia and New Guinea, also elsewhere, but evidently not common.

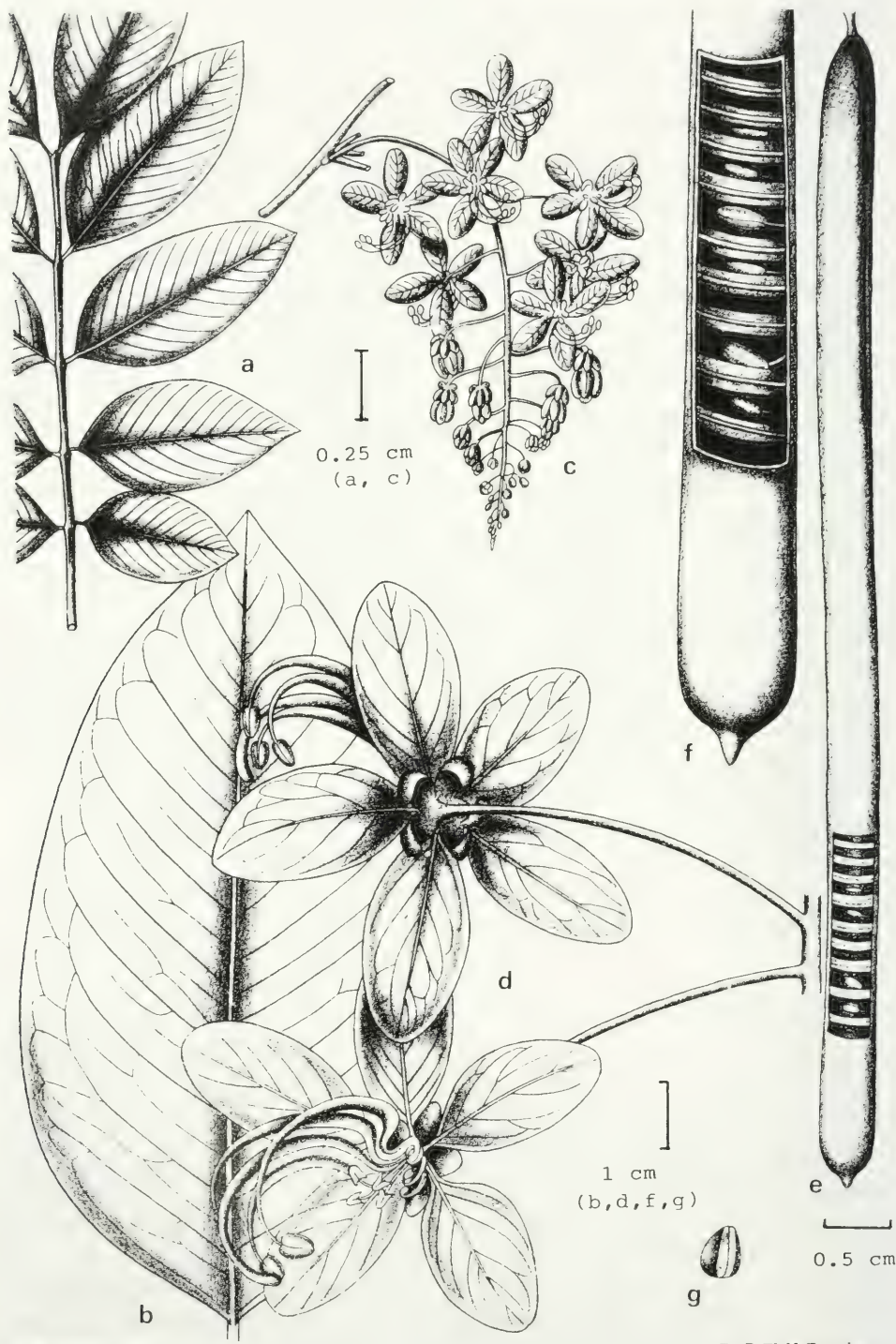
Habitat — Occurring from (200–)500–1500 m altitude.

Note — A hybrid between *Cassia bakeriana* and *C. fistula* has yellowish pink flowers. It is cultivated in West Malaysia under the name 'Rainbow Shower'.

2. *Cassia fistula* L.

Cassia fistula L., Sp. Pl. (1753) 377; Koord. & Valeton, Bijdr. Booms. Java 2 (1895) 11; Koord., Atlas 1 (1913) t. 29; Prain, J. As. Soc. Beng. 66, ii (1897) 156; Merr., Philipp. J. Sc., Bot. 5 (1910) 47; Ridley, Fl. Malay Penins. 1 (1922) 620; Corner, Wayside Trees (1940) 386; de Wit, Webbia 11 (1956) 207; Backer & Bakh. f., Fl. Java 1 (1964) 536; Hô, Illus. Fl. S. Vietnam, ed. 2, 1 (1970) 825, f. 2083; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 41; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 79, pl. 14/1–4; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 14, f. 2; K. & S.S. Larsen in Fl. Thailand 4 (1984) 103, pl. III/4; f. 26/1–4; Rudd in Fl. Ceylon 7 (1991) 62. — Type [Irwin & Barneby 1982; see Taxon 43 (1994) 273]; *Herb. Hermann* vol. 2: 29 (BM).

Deciduous or semideciduous *tree*, 10–15 m tall, rarely more; young twigs glabrous, branches spreading. *Leaves* with 3–7 pairs of leaflets; stipules deltoid, acute, 1–2 mm long, tardily caducous, subglabrous; petiole terete, 5–8 cm long, glabrous; rachis 10–



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30 cm long, terete. *Leaflets* subcoriaceous, ovate-oblong, acute, 7–12 by 4–8 cm, glabrous when mature, shining above; base broadly cuneate; petiolules 4–6 mm. *Racemes* axillary, 1–few together, pendant, lax, many-flowered, 20–40(–60) cm long; peduncle 2–10 cm; bracts 8–10 mm, ovate, acute, puberulous, early caducous; bracteoles 5–7 mm, linear, puberulous. *Flowers* on slender, glabrous pedicels, 3–3.5 cm long. *Sepals* ovate-elliptic, velutinous outside, 7–10 mm long. *Petals* golden-yellow, broadly ovate, subequal, 30–35 by 10–15 cm, shortly clawed. *Stamens* 10: 3 long with filaments 3–4 cm, anthers 5 mm long, opening by apical and basal slits; 4 shorter with filaments 6–10 mm; anthers opening by a basal pore; reduced stamens 3 with filaments 3–4 mm and minute anthers. *Ovary* stipitate, strigulose, style velutinous; stigma small. *Pods* pendulous, terete, glabrous, black, indehiscent, 20–60 cm long, 1.5–2 cm diam. *Seeds* numerous, separated by chartaceous septa and embedded in a glutinous, black pulp, glossy brown, smooth, elliptic, flattened, 8–9 by 5–6 mm. — **Fig. 21.**

Distribution — Probably native of India and Ceylon and perhaps in Burma and N Thailand, now widespread in the tropics, also in the New World. De Wit (l.c.) discusses in detail whether it is native in the Malesian area and compares the distribution with that of the other monsoon species as, e.g., *Bauhinia viridescens*, *B. malabarica*, *B. pottsii*, *Cassia javanica* and *Tectona grandis*, all bicentric in their distribution, avoiding the humid tropics; this points towards a relict distribution pattern. It is thus possible that *C. fistula* is indigenous to the monsoon part of Indonesia. It is most certainly introduced to the Malay Peninsula and the Philippines. It has since long been introduced to China.

Habitat & Ecology — In dry deciduous forests at lower altitudes, in teak forests on Java; it seems to favour calcareous soils and red, volcanic soil; it is also found on sandy and loamy soil in Thailand.

Uses — Besides the ornamental value and the long-time use also in western medicine of the pulp in the ripe pods as a laxative, several other parts of the plants have been and still are in use, e.g. the bark for tanning and as an ingredient in betel paste. A decoction of the roots has been used for purifying wounds. The pods are still imported to health stores in the West. See K. Heyne, *Nutt. Pl. Indon.*, ed. 3 (1950) 741; Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 475.

Note — *Cassia fistula* forms hybrids with *C. javanica* (see also under that species).

3. *Cassia grandis* L. f.

Cassia grandis L. f., *Suppl.* (1781) 230; de Wit, *Webbia* 11 (1956) 212; Backer & Bakh. f., *Fl. Java* 1 (1964) 537; Verdc., *Manual New Guinea Leg.*, *Lac Bot. Bull.* 11 (1979) 45; K. & S.S. Larsen in *Fl. Camb., Laos & Vietnam* 18 (1980) 80, pl. 14/5–6; Irwin & Barneby, *Mem. N.Y. Bot. Gard.* 35 (1982) 30; K. & S.S. Larsen in *Fl. Thailand* 4 (1984) 105, f. 26/5–6; Rudd in *Fl. Ceylon* 7 (1991) 64. — Lectotype (De Wit 1956): *C. G. Dahlberg s.n.* (L), Surinam.

Cassia pachycarpa de Wit, *Webbia* 11 (1956) 259, f. 3. — Type: *Carr 11958* (L holo; K), SE New Guinea.

Fig. 21. *Cassia fistula* L. a. Leaf; b. leaflet; c. inflorescence; d. flowers; e, f. pod and part of it, each with a small part of valve removed; g. seed. Reproduced from Koorders, *Atlas* 1: f. 29.

Semideciduous *tree* up to 20(–30) m high; young branches and inflorescence covered with whitish rusty lanate indumentum. *Leaves* with 10–20 pairs of leaflets; stipules minute, triangular, subulate, early caducous; petiole 2–3 cm, lanate; rachis 10–25 cm. *Leaflets* subcoriaceous, subsessile, elliptic-oblong, 3–5 by 1–2 cm, rounded at both ends. *Racemes* lateral, 10–20 cm long, 20–40-flowered; bracts ovate-elliptic, acuminate, 2–5 mm, caducous; bracteoles similar, but smaller; pedicels 1–2 cm. *Sepals* ovate-obtuse, 5–8 mm, pubescent on both surfaces, finally reflexed. *Petals* at first red, fading to pink and finally orange, the median one red with a yellow patch, 10–15 mm, shortly clawed. *Stamens* 10 with hirsute anthers: 3 long with filaments up to 30 mm and anthers 2–3 mm, opening by short apical and basal slits; 5 with straight filaments, 7–9 mm and anthers 1–1.5 mm; 2 reduced with filaments c. 2 mm. *Ovary* tomentose, style short, stigma inconspicuous. *Pods* pendulous, cylindric-compressed, 20–40(–60) by 3–5 cm, keeled dorsally, woody, rugose, glabrous, blackish. *Seeds* 20–40, ellipsoid, flattened, surrounded by sweetish pulp, 15–20 mm.

Distribution — Tropical America; introduced as ornamental all over the tropics. *Malesia*: several collections seen from the Malay Peninsula, Java and New Guinea.

Habitat & Ecology — Reported as deciduous in the northern Malay Peninsula and in Java. Fl. Aug.–Nov. (cf. De Wit 1956).

Uses — The pulp is used like that of *Cassia fistula* but is more powerful. The wood is reported to be strong and handsome and useful for many purposes.

4. *Cassia javanica* L.

Cassia javanica L., Sp. Pl. (1753) 379; Miq., Fl. Ind. Bat. 1, 1 (1855) 90; Koord. & Valetton, Bijdr. Booms. Java 2 (1895) 8; Prain, J. As. Soc. Beng. 66, ii (1897) 156, 474; Merr., Philipp. J. Sc., Bot. 5 (1910) 48; Koord., Bull. Jard. Bot. Buitenzorg III, 1 (1919) 168; Ridley, Fl. Malay Penins. 1 (1922) 619; Corner, Wayside Trees (1940) 389; de Wit, Webbia 11 (1956) 214; Brenan, Kew Bull. 13 (1958) 180; Backer & Bakh. f., Fl. Java 1 (1964) 537; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 47; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 84, pl. 14/7; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 46; K. & S.S. Larsen in Fl. Thailand 4 (1984) 107, f. 26/7; Rudd in Fl. Ceylon 7 (1991) 66. — Type (De Wit 1956): Commelin, Hort. Med. Amst. 1 (1697) 217, t. 111.

Cassia megalantha Decne., Nouv. Ann. Mus. Hist. Nat. Paris III, 3 (1834) 469, reprinted in Herb. Timor. Descr. (1835) 136; Miq., Fl. Ind. Bat. 1, 1 (1855) 90; de Wit, Webbia 11 (1956) 214, pro syn.

For further synonymy see under the subspecies.

Note — *Cassia javanica* is a very polymorphous species with a wide distribution range from N India through the Indochinese Peninsula and the Malesian region to New Guinea. We agree with Irwin & Barneby (l.c.) that *Cassia pubiflora* and *C. microcalyx* belong here. *Cassia agnes*, *C. nodosa*, *C. renigera*, and *C. bartonii* are also better treated as subspecies; the last two taxa show a certain degree of similarity even if they represent the most westernly and easternly variation of *Cassia javanica*.

We have treated the variation throughout on subspecific instead of varietal level in order to bring the present treatment as close as possible in conformity with the previous treatments in the Flora of Cambodia, Laos & Vietnam and that of Thailand.

KEY TO THE SUBSPECIES

- 1a. Ovary hairy 2
- b. Ovary glabrous 6
- 2a. Inflorescences terminal on leafy shoots **b. subsp. agnes**
- b. Inflorescences lateral on short side branches 3
- 3a. Stipules foliaceous, reniform, more or less falcate to ovate 4
- b. Stipules linear, acute 5
- 4a. Leaflets rounded to obtuse at apex; rachis of inflorescence stout; calyx dark red; petals 2.5–3.5 cm long **a. subsp. javanica**
- b. Leaflets apically acute; rachis of inflorescence slender; calyx green; petals 1.5–2 cm long **e. subsp. nodosa**
- 5a. Sepals 6–9 mm; petals 20–32 mm **f. subsp. pubiflora**
- b. Sepals 4–4.5 mm; petals 15–20 mm **d. subsp. microcalyx**
- 6a. Stipules 2 cm across; petals distinctly clawed, 15–35 mm; pods up to 60 cm long, 2.5 cm broad **g. subsp. renigera**
- b. Stipules 1 cm across; petals narrowed towards the base, 15–18 mm; pods up to 35 cm long, 1–1.3 cm broad **c. subsp. bartonii**

a. subsp. javanica

Cassia javanica L. subsp. *javanica*: K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 84, pl. 14/7; in Fl. Thailand 4 (1984) 107, f. 26/7.

Deciduous *tree* up to 15 m high; young specimens with the trunk armed with stumps of branches; young branches almost glabrous. *Leaves* with 5–15 pairs of leaflets; stipules falcate to pointed, elliptic, attached in the middle; petiole nearly glabrous, 1.5–4 cm; rachis 20–30 cm. *Leaflets* on a short petiolule, elliptic-ovate to oblong, 2.5–5 by 1.5–2.5 cm, apex rounded to blunt, base usually broadly rounded; upper surface feebly shining, lower dull, finely appressed pubescent. *Racemes* arising laterally from the branches, forming corymbs, patent or deflexed, 5–16 cm long; peduncle 2–3 cm; bracts ovate-acute, 10–15 mm long; bracteoles axillary, linear oblong, 4–5 mm long; pedicel 3–5 cm. *Sepals* ovate-acute, dark red to reddish brown, 7–10 mm. *Petals* first pink, later dark red, finally pale, obovate, 25–35 by 7–8 mm, claw 3 mm long. *Stamens* 10; 3 long, recurved, with a spherical enlargement near the middle of the 20 mm long filament, anthers 4 mm, opening by apical and basal slits; 4 shorter ones, c. 10 mm long, with anthers opening by basal pores; 3 reduced stamens c. 10 mm long, with minute anthers. *Ovary* pubescent, slender, recurved on a thin stipe; stigma indistinct. *Pods* terete, black, indehiscent, 20–60 cm long, 1–1.5 cm diam. *Seeds* 50–75, glossy corky, brown, flat, more or less orbicular, embedded in a flat disc. — **Fig. 22.**

Distribution — Widespread in the Malesian area, wild and cultivated. It was described on a specimen from Java. Now widely cultivated all over tropical Asia. According to Irwin & Barneby (l.c.) this subspecies has not been introduced to the American tropics.



Fig. 22. *Cassia javanica* L. subsp. *javanica*. Flowering branch. Pasuruan, Java (*Jeswiet 3576*). Photograph J. Jeswiet.

Habitat — Mainly occurring in the deciduous monsoon forests at lower altitude.

Uses — Cultivated in gardens and as wayside tree; also used for mixed reafforestations. The timber, which is very hard, is used for various purposes. Locally also used as a medicinal plant. See K. Heyne, *Nutt. Pl. Indon.*, ed. 3 (1950) 743; Burkill, *Diet. Econ. Prod. Malay Penins.* (1935) 476.

b. subsp. agnes (de Wit) K. Larsen

Cassia javanica L. subsp. *agnes* (de Wit) K. Larsen, *Nord. J. Bot.* 13 (1993) 403. — *Cassia javanica* L. var. *agnes* de Wit, *Webbia* 11 (1956) 220, f. 1; Irwin & Barneby, *Mem. N.Y. Bot. Gard.* 35 (1982) 50, pro syn. — *Cassia agnes* (de Wit) Brenan, *Kew Bull.* 13 (1958) 180; Verdc., *Manual New Guinea Leg.*, *Lae Bot. Bull.* 11 (1979) 36; K. & S.S. Larsen in *Fl. Camb., Laos & Vietnam* 18 (1980) 82, pl. 14/8; in *Fl. Thailand* 4 (1984) 106, f. 26/8. — Type: A. *Cuadra* 3049 (L. holo), Beaufort.

Tree up to 10 m, deviating by the inflorescences which are stiff panicles 6–9 cm long, terminal on the young leafy shoots, and composed of 6–10 racemes.

Distribution — NE India, Thailand, Laos, Vietnam. Commonly cultivated in tropical Asia and elsewhere. In *Malesia* only known in cultivation; the type is from a cultivated plant.

Habitat — Evergreen and deciduous forests.

c. subsp. bartonii (F.M. Bailey) K. Larsen

Cassia javanica L. subsp. *bartonii* (F.M. Bailey) K. Larsen, *Nord. J. Bot.* 13 (1993) 404. — *Cassia bartonii* F.M. Bailey, *Queensl. Agric. J.* 9 (1901) 410, t. 16; de Wit, *Webbia* 11 (1956) 206; Verdc., *Manual New Guinea Leg.*, *Lae Bot. Bull.* 11 (1979) 40. — Neotype (De Wit 1956): W.S. *Sayers s.n.* (MEL), Queensland.

Similar to subsp. *renigera* but stipules only half as broad and the petals gradually narrowed towards the base. The pods are only 1–1.5 cm in diam. and seem not to surpass 35 cm in length.

Distribution — New Guinea (C and E); by Verdcourt (l.c.) also reported from Bougainville Island and perhaps from Guadalcanal Island.

Habitat — Occurring up to 1000 m altitude.

Note — The petals are pink or pinkish white. De Wit (1956) stated that when better material becomes available, *Cassia bartonii* (*C. javanica* subsp. *bartonii*) might prove to be identical with *C. renigera* (= *C. javanica* subsp. *renigera*).

d. subsp. microcalyx (Irwin & Barneby) K. Larsen

Cassia javanica L. subsp. *microcalyx* (Irwin & Barneby) K. Larsen, *Nord. J. Bot.* 13 (1993) 404. — *Cassia javanica* var. *microcalyx* Irwin & Barneby, *Mem. N.Y. Bot. Gard.* 35 (1982) 51. — Type: *Rahmat Si Toroes* 4898 (NY), Sumatra.

Deviates in having linear-acute stipules like in subsp. *pubiflora*, combined with a tiny calyx of sepals 4–5.5 mm long, petals 15–20 mm long.

Distribution — *Malesia*: Sumatra and Borneo.

Habitat — Mixed evergreen forests at lower altitude.

Note — Irwin & Barneby (l.c.) suggest that their var. *microcalyx* appears to replace other forms of *Cassia javanica* in Sumatra and Borneo; this has to be investigated more closely.

e. subsp. *nodosa* (Roxb.) K. & S.S. Larsen

Cassia javanica L. subsp. *nodosa* (Buch.-Ham. ex Roxb.) K. & S.S. Larsen, Nat. Hist. Bull. Siam Soc. 25 (1974) 205; in Fl. Camb., Laos. & Vietnam 18 (1980) 85; in Fl. Thailand 4 (1984) 108, pl. IV/1; Rudd in Fl. Ceylon 7 (1991) 68. — *Cassia nodosa* Buch.-Ham. ex Roxb., Fl. Ind., ed. Carey, 2 (1832) 336; Ridley, Fl. Malay Penins. 1 (1922) 616; de Wit, Webbia 11 (1956) 223; Backer & Bakh. f., Fl. Java 1 (1964) 537; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 50; H. Keng, Conc. Fl. Sing. (1990) 33. — Type (Irwin & Barneby 1982): authentic collection from Hort. Bot. Cal., distributed as Wall. Herb. no. 5331 (K), a native of Chittagong, India.

Deciduous tree; always with an armed trunk. Differs from subsp. *javanica* in normally having fewer leaflets (5–12 pairs) with an acute apex; the inflorescence axis is usually more slender; and the petals are smaller. In living specimens the green calyx is a distinguishing character.

Distribution — From southern Thailand through the Malay Peninsula, to Java and the Lesser Sunda Islands. It is also widely cultivated in the neotropics.

Habitat — Mixed evergreen forests at lower altitude.

f. subsp. *pubiflora* (Merr.) K. Larsen

Cassia javanica L. subsp. *pubiflora* (Merr.) K. Larsen, Nord. J. Bot. 13 (1993) 403. — *Cassia javanica* var. *pubiflora* Merr., Philipp. J. Sc., Bot. 5 (1910) 48; de Wit, Webbia 11 (1956) 222; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 51. — Lectotype (Irwin & Barneby 1982): *Ahern's collector* 37 (NY), Luzon.

Leaves densely pubescent; stipules linear, acute. Sepals 6–9 mm long; petals 20–32 mm long.

Distribution — *Malesia*: Philippines.

Habitat — In open places, thin forests, etc. at lower altitudes.

g. subsp. *renigera* (Benth.) K. Larsen

Cassia javanica L. subsp. *renigera* (Wall. ex Benth.) K. Larsen, Nord. J. Bot. 13 (1993) 404. — *Cassia renigera* Wall. ex Benth., Trans. Linn. Soc. 27 (1871) 518; Prain, J. As. Soc. Beng. 66, ii (1897) 474; Corner, Wayside Trees (1940) 390; de Wit, Webbia 11 (1956) 225. — Type: Wallich Herb. no. 5207 (K), Upper Burma.

Deviates from the former subspecies in having glabrous ovary; like subsp. *microcalyx* it has small sepals, 4–5 mm long and short but distinctly clawed petals, 15–35 mm long. Pods 2.5 cm diam.

Distribution — Endemic to upper Burma, now introduced in the Malay Peninsula.

Uses — A rapid growing ornamental.

EXCLUDED SPECIES

A number of species of *Cassia* and *Senna* (see p. 673) were occasionally recorded as in cultivation in *Malesia*. They have not been included in the present treatment.

Cassia roxburghii DC. (syn. *C. marginata* Roxb.) is native to S India and Sri Lanka. It has been introduced to W Malaysia as an ornamental ('red *Cassia*') but is not found naturalized or escaped. It is related to *C. javanica* but has smaller leaves, glabrous anthers, the style dilated and abruptly hooked at apex.

CHAMAECRISTA

(K. Larsen & Ding Hou)

Chamaecrista Moench, Meth. Pl. Hort. (1794) 272; Irwin & Barneby, Brittonia 28 (1976) 28; in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 106; Mem. N.Y. Bot. Gard. 35 (1982) 636; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 17, pro syn. — Type species (fide Irwin & Barneby 1982): *Cassia nictitans* L. [= *Chamaecrista nictitans* (L.) Moench, see Taxon 43 (1994) 272].

Cassia sect. *Lasioregma* Vogel, Gen. Cass. Syn. (1837) 8, nom. illeg. — *Cassia* subg. *Lasioregma* Vogel ex Benth. in Fl. Bras. 15, 2 (1870) 129; Trans. Linn. Soc. Lond. 27 (1871) 513, 558; de Wit, Webbia 11 (1956) 278. — Type species (de Wit 1956): *Cassia absus* L. [= *Chamaecrista absus* (L.) Irwin & Barneby].

Herbs or (in Malesian region) rarely small *trees*. *Leaves* paripinnate. Leaflets few (rarely) to many; foliar glands usually present, disc- or cup-shaped, rarely flat. *Flowers* yellow to red. Sepals 5. Petals 5 *Stamens* 10 to 5 fertile; filaments straight; anther-thecae ciliolate along the sutures, dehiscent terminally by slit or pore. *Pods* elastically dehiscent, the valves coiling. *Seeds* with either smooth or pitted seedcoat, always exareolate.

Distribution — About 270 species worldwide; 240 species native to the Americas; few in tropical Asia.

Note — In the circumscription of the genus we are following the concept of Irwin & Barneby in their monograph of the American *Cassiinae*, Mem. N.Y. Bot. Gard. 35 (1982). We are, however, of a different opinion concerning the species delimitation in the section *Chamaecrista*. Here we find that the Asian material justifies the maintenance of the species *Chamaecrista mimosoides*, *C. leschenaultiana*, and *C. pumila*. The whole group, however, needs a renewed study.

KEY TO THE SPECIES

- 1a. Plant viscid; leaflets 2 (or 1) pairs; stamens 5; staminodes absent . . . **1. *C. absus***
- b. Plant not viscid; leaflets 6—many pairs; stamens usually 10, rarely fewer 2
- 2a. Petiolar gland distinctly stipitate **5. *C. pumila***
- b. Petiolar gland sessile 3
- 3a. Tree; leaflets 10–14 pairs, 4–5 mm broad; pods 3- or 4-seeded **4. *C. mindanaensis***
- b. Herb; leaflets usually more than 15 pairs, 1–2.5 mm broad; pods 8–15-seeded . . 4

- 4a. Leaf rachis not canaliculate. Ovary with short, stiff appressed hairs; pods with scattered appressed hairs **3. *C. mimosoides***
 b. Leaf rachis canaliculate. Ovary woolly, with longer, thinner hairs. Pods with long and short, not appressed hairs **2. *C. leschenaultiana***

1. *Chamaecrista absus* (L.) Irwin & Barneby

Chamaecrista absus (L.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 664. — *Cassia absus* L., Sp. Pl. (1753) 537; Miq., Fl. Ind. Bat. 1, 1 (1878) 100; de Wit, Webbia 11 (1956) 279; Backer & Bakh. f., Fl. Java 1 (1964) 537; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 36; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1984) 98; Rudd in Fl. Ceylon 7 (1991) 86. — *Senna absus* (L.) Roxb., Fl. Ind., ed. 2, 2 (1832) 340; ed. Clarke (1874) 351. — Lectotype (Rudd 1991): *Herb. Hermann* 2: 4 (BM holo); *Herb. Hermann fol. 110* (L iso).

Cassia viscidia Zoll. & Mor. ex Zoll., Nat. Geneesk. Arch. Neêrl. Indië 3 (1846) 68 (nomen), 80. — Type: Zollinger 2349, Java.

Herb or small *shrub* up to 60(–100) cm, sticky through viscid bristles. *Leaves* with 2 (or 1) pair(s) of leaflets; stipules linear, acute, 2–4 mm; petiole viscid-bristly, 2.5–3.5 cm; rachis 5–8 mm with a tiny, 0.5 mm long, ligulate-acute gland between each pair of leaflets. *Leaflets* subsessile, membranous, very unequal-sided, ovate-lanceolate, 2–3 by 1–2 cm, apex rounded or acute, base rounded or cuneate; puberulous or pubescent on both surfaces. *Racemes* terminal or axillary, 4–12 cm long, lax-flowered, shortly pedunculate; bracts ovate-auriculate, 2 mm; bracteoles very small; pedicels 3–4 mm, velutinous. *Sepals* narrowly ovate, 3–4 mm, with glandular hairs outside. *Petals* yellow turning brick-red, obovate, subequal, 5–7 mm, claw short. *Stamens* 5, subequal; filaments c. 2 mm; anthers 1–2 mm, with lateral rims opening at apex and gradually downwards to the base; staminodes absent. *Ovary* densely strigose; style glabrous; stigma spatulate, recurved, ciliate. *Pods* flat, on a 5 mm long stalk; strap-shaped, 4–5 by 0.7–0.8 cm. *Seeds* 5–8, ovate, flattish, 3–4 mm.

Distribution — Of palaeotropic origin; in *Malesia*, however, introduced and only locally common as, for instance, in Java, Bali, Timor and Celebes. It was also collected from Penang I. in the north and scattered on the Malay Peninsula; also recorded from New Guinea.

Habitat & Ecology — A weed in open, sunny places up to 900 m altitude; on open soil in eroded areas, old lava streams, waysides, along railroads; according to De Wit (l.c.) it is a conspicuous element in the spring flora on the W Baluran savannas in E Java.

2. *Chamaecrista leschenaultiana* (DC.) Degener

Chamaecrista leschenaultiana (DC.) Degener, Fl. Haw., Fam. 169b (1934) text & fig. — *Cassia leschenaultiana* DC., Mém. Soc. Phys. Genève 2 (1824) 132 ('*leschenaultiana*'); Ridley, Fl. Malay Penins. 1 (1922) 619; de Wit, Webbia 11 (1956) 280; Backer & Bakh. f., Fl. Java 1 (1964) 536; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 48; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 106, pl. 18/9–13; in Fl. Thailand 4 (1984) 123, f. 30/9–13. — Type (De Wit 1956): *Leschenault* ('*Lechenault*') s.n. (G), Bengal.

Cassia patellaria auct. non DC.: de Wit, Webbia 11 (1956) 287.

Herb with woody base or low *shrub* up to 1.5 m high, erect or decumbent; branches more or less densely greyish to yellowish pubescent. *Leaves* with 10–30 pairs of leaflets; stipules persistent, linear, acute, 10–15 mm long; petioles 3–10 mm with a slightly elevated, discoid gland just below the lowest pair of leaflets; rachis 5–12 cm, pubescent, canaliculate, i.e. with 2 parallel crests along the upper side; sometimes in dried specimens close together. *Leaflets* sessile, sensitive to touch (but less so than in *C. mimosoides*), very unequal-sided, more or less falciform, 5–12 by 2–3 mm, glabrous, with ciliate margins; apex rounded oblique, mucronate. *Flowers* in few-flowered, short, axillary or supra-axillary racemes; bracts and bracteoles like the stipules but smaller; pedicels pubescent, 7–10 mm long. *Petals* yellow, unequal, lanceolate to obovate, 6–15 mm long, claw short. *Stamens* (4–)9–10; filaments very short; anthers 5–8 mm, opening by apical pores. *Ovary* woolly with long and short, thin hairs; style glabrous, recurved; stigma flat, ciliate. *Pods* flat, strap-shaped, dehiscent, with long and short non-appressed hairs to nearly glabrous, 3–5 by 0.5 cm. *Seeds* 10–15, black, smooth, flat, 4 by 3 mm.

Distribution — SE Asia (see note 2), widespread in the Malesian area but much less common than *Chamaecrista mimosoides*.

Habitat & Ecology — In continental SE Asia this species is a mountain plant from 500–1600 m altitude; in Java it is also found at lower altitudes and in New Guinea it is reported from *Eucalyptus* and *Melaleuca* forests at sea level, but also up to 1600 m in sandy places and secondary forest.

Notes — 1. We have maintained the old spelling of the name of Leschenault after advice received from the Muséum National d'Histoire Naturelle, Paris.

2. We regard this species as indigenous in SE Asia and are not able to follow Irwin & Barneby in joining it with *Chamaecrista nicticans* as a var. *glabrata*. There is, however, still work to be done with the *C. mimosoides*–*leschenaultiana* complex in tropical Asia; e.g. Verdeourt (l.c.) is of the opinion that in New Guinea a mixture of indigenous and introduced elements occur and one collection from 1600 m ('area 6, Wamena') is an exceptionally robust plant with hairy fruits up to 6.5 by 0.6 cm. Also elsewhere special ecotypes occur; K. & S.S. Larsen (1980: 108) mentioned some very small forms from the Indo-Chinese area. *Cassia leschenaultiana* var. *auricoma* Grah. ex de Wit represents a part of a clinal variation that we do not find necessary to recognize taxonomically.

3. *Chamaecrista mimosoides* (L.) Greene

Chamaecrista mimosoides (L.) Greene, Pittonia 4 (1899) 27; Lock, Kew Bull. 43 (1988) 337. — *Cassia mimosoides* L., Sp. Pl. (1753) 379; Prain, J. As. Soc. Beng. 66, ii (1897) 164; Merr., Philipp. J. Sc., Bot. 5 (1910) 51; Ridley, Fl. Malay Penins. 1 (1922) 619; de Wit, Webbia 11 (1956) 283; Backer & Bakh. f., Fl. Java 1 (1964) 536; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 50; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 105, pl. 18/4–8; in Fl. Thailand 4 (1984) 122, f. 30/4–8; Rudd in Fl. Ceylon 7 (1991) 89. — Lectotype (Rudd 1991): *Herb. Hermann* 2: 13 (BM holo); *Herb. Hermann* 2: 78 (BM syn or iso), *Herb. Hermann, fol.* 85 (L syn or iso), Ceylon.

Cassia mimosoides forma *perennis* de Wit, Webbia 11 (1956) 285. — Type: *de Voogd* 2752 (BO), Bali.

Herb with woody base or low *shrub* up to 1 m, erect or decumbent; branches appressed pubescent. *Leaves* with 20–80 pairs of leaflets, sensitive to touch; stipules linear,



Fig. 23. *Chamaecrista mimosoides* (L.) Greene. a. Habit, about natural size; b. lower part of leaf showing stipules and petiole with a gland just below the lowest pair of leaflets, enlarged. Reproduced from Backer, Onkruidfl. Jav. Suikerrietgr., t. 284.

acute, 5–10 mm, persistent; petioles 3–10 mm, with a flat, discoid, sessile gland just below the lowest pair of leaflets; rachis serrate or crenate, crested along upper side, not canaliculate, sparsely pubescent, 3–10 cm. *Leaflets* sessile, linear, very unequal-sided with more or less parallel sides, (2–)4–8 by 1–2 mm (middle ones), glabrous, sparsely ciliate along the margins; apex acute mucronate, base oblique truncate. *Flowers* supra-axillary, mostly solitary, sometimes 2 or 3 together in a very short raceme; bracts like the stipules; bracteoles similar to the stipules but smaller; pedicels pubescent, 5–10 mm. *Sepals* lanceolate, 4–8 mm long. *Petals* bright yellow, obovate to orbicular, equal to or slightly longer than sepals, claw short. *Stamens* 10–7, filaments 1–2 mm, anthers straight, 2–4 mm, opening by apical pores. *Ovary* covered with stiff, appressed hairs; style glabrous, recurved; stigma flat, ciliate. *Pods* flat, strap-shaped, with scattered appressed hairs to nearly glabrous, 3–6 by 0.5 cm. *Seeds* 10–20, brown, smooth, flat, 4 by 2 mm. — **Fig. 23.**

Distribution — Origin probably in continental SE Asia; it is usually regarded as introduced in the Malesian area and in Africa, as well as in the neotropics. It is a very common species all over tropical Asia.

Habitat — Mainly found in open grassland; also weedy in sunny open places. It occurs from sea level up to 2300 m.

Uses — Of little use; according to De Wit (l.c.) it has been tried as a green manure in tea plantations on Sumatra. Possible medicinal value is discussed by Quisumbing, *Med. Pl. Philipp.* (1951) 382. See also Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 477; K. Heyne, *Nutt. Pl. Indon.*, ed. 3 (1950) 744.

Note — Widespread and polymorphous species not yet fully understood; we have not maintained De Wit's forma *perennis* as this is certainly only one of the several ecotypes.

4. *Chamaecrista mindanaensis* (Merr.) K. Larsen

Chamaecrista mindanaensis (Merr.) K. Larsen, *Nord. J. Bot.* 13 (1993) 404. — *Cassia mindanaensis* Merr., *Philipp. J. Sc.* 20 (1922) 388; de Wit, *Webbia* 11 (1956) 286. — Type: *Mataya FB 28245* (NY), Mindanao.

Shrub or small *tree* up to 5 m tall; young parts puberulous later glabrous. *Leaves* with (7–)10–14 pairs of leaflets; stipules linear-lanceolate, acuminate, 3 mm long; petioles up to 1 cm, with a sessile truncate gland halfway between the base and the lower pairs of leaflets; rachis 7–10 cm. *Leaflets* subcoriaceous, oblong, sessile, glabrous when mature, 1–2.5 by 0.3–0.6 cm; apex obtuse, minutely apiculate, base rounded. *Flowers* in supra-axillary, few-flowered, short racemes, often in pairs; bracts linear-lanceolate, c. 2 mm long; bracteoles similar, near the apex of the pedicel. *Sepals* lanceolate to elliptic-lanceolate, c. 8 mm long, densely appressed pubescent in the lower half. *Petals* yellow, obovate, glabrous, 10 by 7–8 mm. *Stamens* 10, subequal; filaments c. 1 mm; anthers 3.5–5 mm. *Ovary* and style 8–10 mm long, appressed pubescent; stigma indistinct from the style, with a bundle of hairs at the apex. *Pods* narrowly oblong, oblique at both ends, 3–5 by 0.6–0.8 cm, sparsely pubescent. *Seeds* 3 or 4, subrhomboidal, flat, c. 6 by 4 mm.

Distribution — *Malesia*; Philippines (Mindanao).

Habitat — Along banks or forested slopes of streams, from lowland to 500 m altitude.

5. *Chamaecrista pumila* (Lam.) K. Larsen

Chamaecrista pumila (Lam.) K. Larsen, Nord. J. Bot. 13 (1993) 404. — *Cassia pumila* Lam., Encycl. Méth. Bot. 1 (1785) 651; de Wit, Webbia 11 (1956) 288; Backer & Bakh. f., Fl. Java 1 (1964) 537; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 104, pl. 18/1–3; in Fl. Thailand 4 (1984) 120, pl. IV/3, f. 30/1–3.

Decumbent or erect, short-lived *herb* with woody base or *undershrub* rarely surpassing 50 cm in height; branches pubescent. *Leaves* with 10–25 pairs of leaflets, sensitive to the touch; stipules linear acute, 5–10 mm, persistent; petiole 5–7 mm, pubescent, provided with a long stipitate gland below the lower pair of leaflets. *Leaflets* sessile, unequal-sided, with parallel sides, 7–12 by 2–3 mm; glabrous or with few hairs along the midrib; apex rounded with a long mucro. *Flowers* supra-axillary, solitary or most often 2 or 3 together in a very short raceme; bracts and bracteoles similar to the stipules, but shorter; pedicels pubescent, 4–6 mm. *Sepals* lanceolate, acute, 5–6 mm long. *Petals* bright yellow, unequal, oblong obovate, 2–3 mm long, claw short. *Stamens* 5, subequal; filaments 1–1.5 mm; anthers straight, 1.5–2 mm, opening by apical pores enlarging to short slits. *Ovary* appressed tomentose; style glabrous, recurved; stigma small, peltate. *Pods* flat, strap-shaped, dehiscent, thinly pubescent, 2–5 by 0.5 cm. *Seeds* 10–15, brown, smooth, flat, subrhomboidal, 3 mm.

Distribution — Tropical Asia to Australia. Scattered in *Malesia*, but common only in few areas as e.g. in Sumbawa; there are also several collections from Java, Flores and Timor.

Habitat & Ecology — At low altitudes, not found above 300 m; in open habitats along roads and waste places on stony, sandy soil, also on limestone; all in all similar habitats as *C. mimosoides*.

Note — The petiolar gland shows quite a wide range of variation, but even if it is rather shortly stipitate in some specimens, *Chamaecrista pumila* is readily distinguishable from *C. mimosoides*.

COPAIFERA

(Ding Hou)

Copaifera L., Sp. Pl., ed. 2 (1762) 557, nom. cons.; Ding Hou, Blumea 38 (1994) 320. — Type species: *Copaifera officinalis* (Jacq.) L.

Pseudosindora Sym., Proc. Linn. Soc. Lond. 155 (1944) 285. — Type species: *Pseudosindora palustris* Sym. [= *Copaifera palustris* (Sym.) de Wit].

Trees. *Leaves* imparipinnate, petiolate. *Stipules* caducous. *Leaflets* alternate, petiolulate. *Inflorescences* axillary, paniculate; bracts and bracteoles small, caducous. *Flowers* bisexual, actinomorphic, pedicelled. *Hypanthium* unknown. *Calyx* lobes 4, narrowly imbricate or subvalvate. *Petals* unknown. *Disk* unknown. *Stamens* 10, free; anthers dorsifixed. *Ovary* stipitate, 2-ovuled; style slender; stigma small, capitellate. *Pods* ellipsoid, rather smooth, 2-valved, valves thick coriaceous, 1- or 2-seeded. *Seeds* oblong, arillate, exalbuminous.



Fig. 24. *Copaifera palustris* (Sym.) de Wit. a. Fruiting branch; b, c. valves of two opened pods showing one and two young arillate seeds respectively (a, b: J.A.R. Anderson 8565; c: Smythies, Wood & Ashton SAN 17427). Drawing Ding Hou.

Distribution — Species 25–30, mostly in tropical America, 4 in tropical Africa, and 1 in *Malesia* (Borneo).

Habitat — In Malesia, see under the species.



Fig. 25. *Copaifera palustris* (Sym.) de Wit. Tree form. Seria, Brunei. Photograph P.S. Ashton, 1959.

Copaifera palustris (Sym.) de Wit

Copaifera palustris (Sym.) de Wit, Webbia 9 (1954) 462; Ding Hou, Blumea 38 (1994) 321. — *Pseudosindora palustris* Sym., Proc. Linn. Soc. Lond. 155 (1944) 285, f. 1 & 2; Browne, For. Trees Sarawak and Brunei (1955) 242. — Type: *C. O. Flemmich FMS 32600* (KEP holo), Brunei.

Tree up to 30(–39) m high and 0.4(–1.8) m in diam. *Leaves* (2–)4(–6)-foliolate; stipules auriculate to subfalcate, up to 1.5 by 1 cm; petiole and rachis 4.5–12 cm, glabrous. *Leaflets* coriaceous, elliptic-oblong, often unequal-sided, 5–9(–14) by 3.5–6(–8) cm; apex acute or shortly acuminate; base rotund; glossy, pellucid-dotted, glabrous except sometimes sparsely hairy on the midrib or at the base on the lower surface, glabrescent; nerves many, distinct or visible on both surfaces; often with 1–3 elliptic, slightly depressed glands towards the basal part of the margin; petiolules 4–7 mm. *Inflorescences* 4–11 cm long; pedicels 3–4 mm. *Calyx* lobes elliptic, 4–7.5 by 2–4 mm, puberulous outside, densely tomentose inside. *Stamens* alternately long and short; filaments 7–10 mm; anthers c. 2 mm long. *Ovary* 2–3 by 1–1.5 mm, style 4.5–5 mm. *Pods* 4.5–7.5 by 3.5–4 cm. *Seeds* 2.4–2.7 by c. 1.5 cm, glossy brown or black; aril narrowly 2-lobed, enclosing the seed. — **Fig. 24, 25.**

Distribution — *Malesia*: Borneo (Brunei, Sabah, Sarawak, Kalimantan).

Habitat & Ecology — In freshwater peat swamp forest near the coast, sometimes also found in dry lowland forest, once found in secondary heath forest. 0–30 m altitude. Fl. April, Oct.; fr. July.

Uses — The timber of the present species is similar to that of *Sindora* species and can be used for the same purposes [Sambas in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 437].

CRUDIA

(Ding Hou)

Crudia Schreber, Gen. 1 (1789) 282, nom. cons.; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 411; Cowan & Polhill in Polhill & Raven, Adv. Leg. Syst. 1 (1981) 131; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 21. — *Apalatoa* Aublet, Hist. Pl. Guiane (1775) 384, nom. rej. — Type species: *Apalatoa spicata* Aublet, typ. cons. [= *Crudia spicata* (Aublet) Willd.].

Touchiroa Aublet, Hist. Pl. Guiane (1775) 384, nom. rej. — Type species: *Touchiroa aromatica* Aublet. *Pryona* Miq., Fl. Ind. Bat. 1, 1 (1858) 1081. — Type species: *Pryona bantamensis* (Hassk.) Miq. [= *Crudia bantamensis* (Hassk.) Benth.].

Trees or shrubs, rarely *scramblers*. *Stipules* usually intrapetiolar, small or rarely large, often connate (at the basal parts), sometimes interpetiolar and free, caducous or persistent. *Leaves* spiral, imparipinnate or seemingly paripinnate (sometimes with a prolonged tip of rachis beyond the apical leaflet, often deciduous), 1–9(–13)-foliolate, petioled. *Leaflets* alternate, very rarely opposite; midrib usually slightly grooved above and elevated beneath; nerves slightly patent, ascending and arcuately anastomosing extending towards near the margin, usually slightly impressed above and prominent beneath; veins often faintly loosely reticulate, usually obscure or invisible above, obscure or sometimes distinct beneath; petiolules short. *Inflorescences* racemose, axillary or terminal, very rare-

ly cauline (*C. cauliflora*), solitary or fasciculate; bracts entire or lobed (sometimes 3-lobed with the central lobe redivided), often caducous, sometimes persistent; bracteoles 2, (sub)-opposite or alternate, often minute or small, or relatively large and enclosing the young flower buds, often caducous, sometimes persistent; pedicels rather short, articulated. *Flowers* bisexual. *Hypanthium* (or receptacle) shortly cupular or campanulate. *Calyx* lobes 4, imbricate, often ciliate on the margin, reflexed during flowering. *Corolla* absent. *Disk* absent (or a protruding rim or ring round the mouth of hypanthium). *Stamens* 10 or fewer, often caducous; filaments united at their basal parts, sometimes seemingly free, \pm equal or slightly unequal in length; anthers small, ovoid, ellipsoid, or oblong, dorsifixed, longitudinally dehiscent. *Pistil* shortly stipitate, stipe free or (partly) adnate to the hypanthium; ovary elliptic or ovate, often densely hairy, 1–6-ovuled; style filiform; stigma terminal, small, knob-like. *Pods* obliquely orbicular, ellipsoid or ovoid, coriaceous or slightly woody, compressed or somewhat swollen, dehiscent, 2-valved, 1–4(–6)-seeded. *Seeds* suborbicular or subreniform, compressed, cotyledons concave, exarillate, exalbuminous.

Distribution — A tropical genus consisting of c. 50 species, distributed in America, Africa, and Asia; in *Malesia* 30 species, including 2 doubtful ones.

Habitat & Ecology — In lowland forest, sometimes occurring up to 400 m altitude. De Wit (1950: 411) found that “the cotyledons are concave with a large inner cavity (also found, e.g., in *Entada*), which may cause buoyancy and promote dispersal.”

Note — The important, main reference for Malesian *Crudia* is the comprehensive revision published by De Wit (l.c.: 407–434).

KEY TO THE SPECIES

- 1a. Infructescences cauline (inflorescence unknown). Leaves 1-foliolate. Pods densely pubescent, 2- or 3-seeded **6. *C. cauliflora***
- b. Inflorescences and/or infructescences axillary and/or terminal 2
- 2a. Leaflets entirely glabrous on the lower surface 3
- b. Leaflets velutinous-hirsute to minutely apressedly puberulous (at least on the midrib and nerves), rarely glabrescent and seemingly glabrous, on the lower surface 11
- 3a. Stipules falcate, or foliaceous, 5–9 mm long 4
- b. Stipules ovate, very small or minute, up to 3.5 mm long 6
- 4a. Stipules connate at the base, 5–6 mm long. Leaves (1–)2–3(–4)-foliolate. Bracts at the base of peduncles usually subulate, up to 8 mm long, sometimes aggregate, surrounding the base and brush-like **17. *C. reticulata***
- b. Stipules free, 7.5–9 mm long. Bracts at the base of peduncles ovate, c. 3 mm long, not as above 5
- 5a. Stipules up to 7.5 mm long. Leaves (4–)5–6-foliolate. Pods obliquely obovate, 11 by 5–6 cm, puberulous **13. *C. mutabilis***
- b. Stipules 9 mm long. Leaves 4- or 5-foliolate. Pods elliptic to elliptic-obovate, up to 15 by 6–7 cm, brown velvety **21. *C. splendens***

- 6a. Leaves 1- or 2-foliolate 7
- b. Leaves 3- or 4-foliolate, rarely associated with some 1- or 2-foliolate ones (in *C. gracilis*) 8
- 7a. Leaves usually 1-foliolate, when 2-foliolate then leaflets often not opposite. Ovary 3- or 4-ovuled **22. *C. subsimplicifolia***
- b. Leaves usually with 2 opposite leaflets, sometimes 1-foliolate. Ovary 2-ovuled ..
..... **15. *C. papuana***
- 8a. Pedicels long, (7–)15–22(–30) mm. Calyx lobes usually puberulous on the cen-
tral, longitudinal part inside. Pods shining **23. *C. tenuipes***
- b. Pedicels very short, 0–2 mm. Calyx lobes glabrous inside 9
- 9a. Inflorescences erect, up to c. 5 cm long, rachis scurfy-velvety. Calyx lobes vel-
vety outside. Ovary 6-ovuled **9. *C. evansii***
- b. Inflorescences pendulous, longer, 8–30 cm long, rachis glabrous. Calyx lobes
glabrous outside 10
- 10a. Leaves (1–)3-foliolate. Stamens 8 or 9 **10. *C. gracilis***
- b. Leaves 4-foliolate. Stamens 5 **16. *C. penduliflora***
- 11a. Bracts usually lanceolate to linear, 7–15 mm long. Bracteoles 6–9 mm long . 12
- b. Bracts and bracteoles, if present, usually very small, less than 5 mm long ... 13
- 12a. Pedicels 6–15 mm, articulated at the apex; bracteoles 2, opposite, at the apex of
the pedicel. Pods velvety **5. *C. caudata***
- b. Pedicels 15–20 mm, articulated at the base; bracteoles 2, subopposite or alternate,
at the upper half of the pedicel. Pods shortly hairy **14. *C. ornata***
- 13a. Leaflets rotund or apiculate at the apex. Leaves (1- or) 2-foliolate. Pods brownish
hairy **27. *C. viridiflora***
- b. Leaflets often acuminate, caudate, or cuspidate at the apex 14
- 14a. Leaves usually 2- or 3-foliolate 15
- b. Leaves usually more than 3-, up to 13-foliolate 19
- 15a. Stipules free. Inflorescences very short, up to 2.5 cm long. Flowers almost ses-
sile. Pods densely ferruginous velvety, 1- (or 2-)seeded **8. *C. dewitii***
- b. Stipules connate at the base. Inflorescences much longer, 5–55 cm long. Flowers
distinctly pedicelled 16
- 16a. Inflorescences 5–7 cm long. Pedicels 5–6 mm long. Pods finely rugulose
..... **11. *C. katikii***
- b. Inflorescences much longer, 12–55 cm long. Pedicels less than 2.5 mm. Pods (as
now known) smooth 17
- 17a. Climber. Inflorescences pendulous, up to 55 cm long, rachis glabrous. Ovary
2-ovuled **20. *C. sparei***
- b. Tree. Inflorescences erect or pendulous, 12–45 cm long, rachis (densely) puber-
ulous. Ovary 3–5-ovuled 18
- 18a. Inflorescences erect, up to 12 cm long. Bracteoles at the apex of pedicel. Fila-
ments of stamens 3–7(–10) mm **25. *C. velutina***
- b. Inflorescences pendulous, up to 45 cm long. Bracteoles on the pedicel. Filaments
of stamens up to 12 mm **2. *C. bantamensis***

- 19a. Leaves 9–13-foliolate. Pedicels 6–15 mm, with 2 bracteoles at the middle. Ovary 1- or 2-ovuled; style very short, c. 2 mm **19. *C. scortechinii***
 b. Leaves usually less than 9-foliolate 20
- 20a. Inflorescences pendulous, 20–31 cm long 21
 b. Inflorescences erect, usually 9–17 cm long 23
- 21a. Pedicels (1.5–3 mm) articulated at the apex **1. *C. acuta***
 b. Pedicels (2–7 mm) articulated at the base 22
- 22a. Leaves (2- or) 3- or 4-foliolate. Calyx lobes broadly ovate or suborbiculate, 3–4 by 2.5–3 mm. Style very short, c. 3 mm **12. *C. lanceolata***
 b. Leaves 5- or 6(–8)-foliolate. Calyx lobes elliptic, 5–6 by 3 mm. Style long, up to 12 mm **18. *C. ripicola***
- 23a. Pedicels 6–15 mm, articulated at the apex. Ovary 2- (or 1-)ovuled. Style c. 2 mm. Leaves 6–9- (or 10-)foliolate **7. *C. curtisii***
 b. Pedicels usually shorter, 2–5(–6) mm 24
- 24a. Pedicels articulated at the apex 25
 b. Pedicels articulated at the base 26
- 25a. Leaves 7- or 8-foliolate. Ovary 2- or 3-ovuled; style very short, 1–2.5 mm. Pods rather small, 2.5–4 by 1.5–2 cm **4. *C. blancoi***
 b. Leaves 3- or 4-foliolate. Ovary 4(–6)-ovuled; style up to 6 mm. Pods unknown **3. *C. beccarii***
- 26a. Filaments of stamens alternately longer and shorter **26. *C. venenosa***
 b. Filaments of stamens almost equal in length 27
- 27a. Leaves 3–7-foliolate. Bracts small, 1–1.5 mm long. Ovary (3- or) 4-ovuled; style 3.5–6 mm **24. *C. teysmannii***
 b. Leaves 3- or 4-foliolate. Bracts larger, up to 4 mm long. Ovary 2(–4)-ovuled; style c. 8 mm **28. *C. wrayi***

1. *Crudia acuta* de Wit

Crudia acuta de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 415. — Type: *Achmad 1646* (BO holo, n.v.; L), Simalur Isl.

Tree to 8 m high. *Stipules* intrapetiolar, 1–2 mm long, sparsely puberulous outside, slightly hairy on edge. *Leaves* (2–)3–4(–6)-foliolate, shortly petioled; petiole and rachis 2.5–13.5 cm long. *Leaflets* chartaceous, obovate, oblanceolate, 9–15(–20) by 3.5–6.5 cm, apex abruptly, shortly caudate to cuspidate; base cuneate to attenuate, often unsymmetric; glabrous above, loosely, minutely appressedly puberulous, glabrescent (or almost glabrous except on the midrib) beneath; nerves 5–7 per side; petiolules 3–5 mm, glabrous. *Inflorescences* axillary, solitary, 20–30 cm long, pendulous, rachis puberulous, rather densely flowered; bracts c. 2 mm long, the outer ones ovate, inner ones 3-lobed (the middle lobe redivided into a 3–5-pointed fork) and fan-shaped, caducous, deciduous or persistent, puberulous, glabrescent, often minutely ciliate on the margin; bracteoles minute, triangular, 0.35–0.75 mm long; pedicels 1.5–3 mm, articulated at the apex, puberulous. *Flowers* yellowish or greenish white, puberulous outside, gla-

brесcent, glabrous inside. *Hypanthium* c. 1 mm long. *Calyx* lobes oblong-ovate or ovate, 3–4 by 1.5–2 mm. *Stamens* 10; filaments 4–7 mm, glabrous; anthers 0.75 mm long. *Pistil* stipitate; stipe 1–1.5 mm long, free, glabrous; ovary c. 3 mm long, 4- (or 5-) ovuled; style 3–5 mm, glabrous, recurved; stigma minute, round. *Pods* not seen.

Distribution — *Malesia*: Sumatra (Simalur Isl., Indragiri, and Lampong).

Habitat & Ecology — In marshy or drier forest, 5–400 m altitude. Fl. Jan.

Note— There are several bracts at the base of the peduncle, which were described as 'peduncular bracts' by De Wit (1950: 410). These bracts appear to be 3-lobed, and the middle one redivided towards the lower one-third into a 4- (or 5-) pointed, more or less fan-shaped, hairy fork.

2. *Crudia bantamensis* (Hassk.) Benth.

Crudia bantamensis (Hassk.) Benth., Trans. Linn. Soc. 25 (1868) 315; Fischer, Kew Bull. (1932) 73; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 415, f. 1; Backer & Bakh. f., Fl. Java (1964) 527. — *Touchiroa? bantamensis* Hassk., Retzia 1 (1885) 202. — *Pryona bantamensis* (Hassk.) Miq., Fl. Ind. Bat. 1, 1 (1858) 1081. — *Apalaioa bantamensis* (Hassk.) Baillon, Hist. Pl. 2 (1869-70) 104. — Lectotype (de Wit 1950): *Anonymus s.n.*, March 1925 (BO holo; L), cult. Java, Bot. Gard. Bogor, under nr. I-i-38. See note 1.

Tree to 16 m high and 15(–35) cm in diam. *Stipules* intrapetiolar, 3.5–4.5 mm long. *Leaves* (1- or 2- (or 3-) foliolate (usually one leaflet early shed and two persistent), short-ly petioled; petiole and rachis 0.5–2.5 cm long. *Leaflets* chartaceous, subcoriaceous or coriaceous, obovate- or elliptic-oblong, or oblanceolate, 12–24 by 4–6.5(–9) cm; apex acute, abruptly or gradually, shortly acuminate, sometimes rounded to submarginate; base acute, obtuse or rotund, often symmetric; glabrous above, minutely, loosely, appressedly puberulous, glabrescent (or almost glabrous except on the midrib) beneath; nerves 5–7 per side; petiolules 1.5–5 mm, glabrous. *Inflorescences* axillary, up to 45 cm long, pendulous, the rachis puberulous, rather densely flowered; bracts 2–3.5 mm long, ovate or triangular, or 3-lobed at about the upper 1/3 (the middle lobe redivided into a 3-pointed fork), puberulous, glabrescent, often minutely ciliate on the margin; bracteoles 2, opposite, small, ovate or triangular, 0.35–0.75 mm long, puberulous on both surfaces, glabrescent, usually persistent; pedicels 1–2 mm, articulated at the apex, puberulous. *Flowers* white, yellowish white, or pale green, loosely puberulous outside, glabrescent, glabrous inside. *Hypanthium* shortly cupular, c. 1.5 mm long. *Calyx* lobes elliptic or ovate, 3–4 by 1.5–2 mm. *Stamens* 8–10; filaments up to c. 12 mm, glabrous; anthers ellipsoid, 0.75 mm long. *Pistil* stipitate; stipe c. 1 mm long, free, glabrous; ovary c. 3 mm long, 3–5-ovuled; style 6–8 mm, glabrous, recurved; stigma minute, round, discoid. *Pods* oblong, ovate or broadly elliptic, 4–9 by 2–4 cm long, rugose, slightly beaked, dehiscing into 2 crooked, rather thin valves, 1–4-seeded. *Seeds* slightly reniform, or irregularly rounded, 3–3.75 by 1.75–3 cm, rather smooth. — **Fig. 26.**

Distribution — *Malesia*: W Java and Borneo (Sabah and Kalimantan).

Habitat & Ecology — Lowland forest, up to 350 m altitude, scattered, sometimes locally common. Fl. Jan., Feb., July–Sept., Dec.; fr. July, Sept., Dec.



Fig. 26. *Crudia bantamensis* (Hassk.) Benth. Habit and flower details. Photograph of a water-colour drawn by J. van Aken. Original plate in Leiden; photograph B. Kieft, $\times 0.5$.

Notes — 1. Hasskarl (l.c.) based his new species *Touchiroa? bantamensis* on living plants cultivated in the Botanical Garden Bogor, without designating the type. Dr Elizabeth Widjaja (in litt.) informed me that there is no herbarium specimen of that species made by Hasskarl in BO. For the type of this species, De Wit (l.c.) appointed the specimen collected in March 1925 by an unknown collector, from a tree originating from a Hasskarl collection from Bantam (W Java) in 1841, and cultivated in the Botanical Garden Bogor, under the number of I-I-38, as cited above.

2. This species is said to be found often in W Java. Fischer (l.c.) reported one collection of it from Sabah (*Arsat 1244*, SAN). I have not seen this specimen. Recently the species was found in E Kalimantan (Wanariset): *Ambri & Arifin W845*. L. Cultivated in Java (Hort. Bog., sub no. I-B-5a, I-I-38 & 38a).

3. *Crudia beccarii* Ridley

Crudia beccarii Ridley, Kew Bull. (1929) 257; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 418. — Type: *Beccari PB 3903* (K holo; L photos), Sarawak.

Tree to 25 m high, 40 cm in diam. *Stipules* intrapetiolar, c. 3 mm long. *Leaves* 3- or 4-foliolate, shortly petioled; petiole and rachis 1.5–3 cm long, prolonged beyond the upper petiolule into a very short tip. *Leaflets* chartaceous or subcoriaceous, obovate, obovate- or elliptic-oblong, or elliptic, 6–14 by 2.5–5 cm; apex abruptly acuminate; base obtuse or rounded, often symmetric; glabrous above, minutely appressedly hairy, sometimes glabrescent, or almost glabrous beneath; nerves 5–7 per side; petiolules c. 5 mm, glabrous. *Inflorescences* axillary or terminal, up to 14 cm long, erect, rather densely flowered; bracts triangular or subulate, 0.75–4 mm long, puberulous outside; bracteoles 2, minute, triangular, c. 0.5 mm long; pedicels 2–3 mm long, articulated at the base, slightly, minutely puberulous. *Flowers* slightly, minutely, appressedly puberulous (on the uncovered part of the calyx lobes) outside. *Hypanthium* c. 1 mm long, glabrous inside. *Calyx* lobes ovate, broadly elliptic, or slightly obovate, 3–3.5 by 2 mm, glabrous inside. *Stamens* (9 or) 10; filaments 5–7 mm; anthers c. 0.7 mm long. *Pistil* stipitate; stipe free, c. 1 mm long, glabrous; ovary c. 2 mm long, 4(–6)-ovuled; style up to c. 6 mm, glabrous; stigma obscure. *Pods* broadly ellipsoid or slightly obovoid, 3.5–4.3 by c. 2.5 cm, flattened.

Distribution — *Malesia*: Borneo (Brunei, Sarawak, Kalimantan).

Habitat & Ecology — Lowland forest, 20–50 m altitude. Fl. July; fr. Oct..

4. *Crudia blancoi* Rolfe

Crudia blancoi Rolfe, J. Linn. Soc., Bot. 21 (1884) 309; Merr., Sp. Blanc. (1918) 170; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 419, f. 2. — *Apalotoa blancoi* (Rolfe) Merr., Bur. Govt. Lab. Philipp. 35 (1906) 19. — Type: extant ?; illustrative specimen: *Merrill Sp. Blanc.* 882 (L), Luzon. *Crudia spicata* auct. non Willd.: Blanco, Fl. Filip., ed. 2 (1845) 261; ed. 3, 2 (1878) 121, t. 244 ('*Crudya*').

Tree to 28 m high. *Stipules* intrapetiolar, minute. *Leaves* 7–9-foliolate, shortly petioled; petiole and rachis 5–11.5 cm long, prolonged c. 5 mm beyond the top leaflet.

Leaflets chartaceous, ovate or elliptic-ovate 4–9(–21) by 1.5–3(–7) cm; apex shortly acuminate to acuminate; base obtuse or rotund, slightly unsymmetric; sparsely puberulous or almost glabrous above, minutely, loosely, appressedly puberulous, glabrescent (or almost glabrous except on the midrib) beneath; nerves 5–8, sometimes more per side; petiolules very short, 1–2 mm, glabrous. *Inflorescences* axillary or terminal, usually erect, 13–17(–27) cm long, the rachis puberulous, rather densely flowered; bracts caducous or wanting, if present then ovate or triangular, up to 5 mm long, glabrous; bracteoles very small, subulate, 0.35–1 mm long; pedicels 2–3.3(–6?) mm, articulated at the apex, puberulous. *Flowers* white, puberulous, glabrescent, or almost glabrous outside. *Hypanthium* c. 1 mm long. *Calyx* lobes ovate, broadly elliptic, elliptic, or obovate, 3–4 by 1.5–2.5 mm, usually puberulous inside. *Stamens* 10; filaments 5–7 mm, usually glabrous; anthers 0.75 mm long. *Pistil* shortly stipitate; stipe c. 0.5 mm long, free, glabrous; ovary c. 3 mm long, 2- or 3-ovuled; style short, 1–2.5 mm, glabrous or slightly hairy at the basal part; stigma indistinguishable. *Pods* solitary or a few together, ellipsoid or broadly ellipsoid, 2.5–4 by 1.5–2 cm, usually 1-seeded. *Seeds*: only very young one seen.

Distribution — *Malesia*: Philippines (Luzon), Moluccas (Tanimbar Is.), and Papua New Guinea (Western Prov.).

Habitat & Ecology — In thickets, savanna riverside vegetation, and in primary forests, chiefly along streams at low and medium altitudes. Fl. July.

Note — The flowers of this species have a very short style, 1–2.5 mm long. De Wit (l.c.: 419, f. 2) correctly recorded the length of the style as “2 to 2.5 mm long” in the description, but it was erroneously drawn by a draftsman as long as 8–10 mm.

5. *Crudia caudata* Prain

Crudia caudata Prain, J. As. Soc. Beng. 66, ii (1897) 219, 488; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 422; Whitmore in Tree Fl. Malaya 1 (1972) 249; J.E. Vidal in Fl. Thailand 4 (1984) 92.

— Type: *Ridley 6399* (K holo; BM, L photos), Malay Peninsula.

Crudia bracteolosa de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 421. — Type: *Cult. Hort. Bogor. no. XI-A-121*, origin from Borneo? (BO holo; L).

Tree 25 m high. *Stipules* more or less intrapetiolar, triangular to lanceolate, up to 7 (–13) mm long. *Leaves* (4–)6–8-foliolate, shortly petioled; petiole and rachis up to 10 cm long, ending in a subulate tip (up to 10 mm long), rusty tomentose. *Leaflets* chartaceous or subcoriaceous, elliptic-oblong or obovate-oblong, 7–9(–15) by 2–3(–4) cm; apex acuminate or caudate; base obtuse, rounded, or cuneate, symmetric; glossy, glabrous above, rusty pubescent (often dense on the midrib) beneath; nerves 5–8 per side; petiolules very short, 1–2 mm, pubescent. *Inflorescences* axillary or terminal, usually erect, up to c. 15 cm long, the rachis rusty tomentose, rather densely flowered; bracts ovate to lanceolate, sometimes oblanceolate, (5–)7–9 mm long, pubescent outside and glabrous inside, some of them 3-lobed and the central lobe imparipinnately relobed; bracteoles lanceolate or spoon-shaped, 6–9 mm long, almost enclosing the bud; pedicels 10–15 mm, pubescent, articulated at the apex. *Flowers* pubescent outside. *Hypanthium* 2–2.5 mm long. *Calyx* lobes 4 (sometimes with 1 or 2 additional, smaller, gla-

brous ones), ovate, unequally sized, 5–7 by 3.5–5 mm, glabrous inside. *Stamens* 10, or rarely 9; filaments unequal in length, up to c. 15 mm; anthers 0.75 mm long. *Pistil* shortly stipitate; stipe c. 2 mm long, free, glabrous; ovary c. 3 mm long, (4–)6-ovuled; style 8–17 mm, glabrous or slightly hairy at the basal part; stigma slightly thicker than the style. *Pods* (unripe) elliptic, ovate-oblong, or obovate, 7–10 by 2.5–3.5 cm, flat, cuneate at both ends, rusty, velvety, valves thinly leathery, usually 1-seeded. *Seeds* shortly oblong, broadly elliptic, or rounded, flat, 3–4 by 2–3 cm.

Distribution — Thailand (Peninsula, once collected); in *Malesia*: Malaya (Trengganu, Johore), Borneo (Sarawak, W Kalimantan).

Habitat & Ecology — In forest on riverbanks, and freshwater swampy areas, level land or at a few m altitude. Fr. June, July.

Notes — 1. The plants which were in the past cultivated in the Botanic Garden of Bogor, Java, have died.

2. Specimens of this species can be easily distinguished from others in this genus by the caudate leaf apex, as alluded by the specific epithet, and (densely) rusty tomentose young branchlets, leaf undersurface (especially on the midrib), leaf rachises and inflorescences.

3. The ovary is not 1-ovuled (cf. J.E. Vidal 1984: 92); it is actually (4–)6-ovuled.

6. *Crudia cauliflora* Merr.

Crudia cauliflora Merr., J. Arnold Arbor. 35 (1954) 136. —Type: BS 34092 (A holo), Philippines.

Small *tree*; branchlets glabrous, terete, ultimate ones 1 cm in diam. *Leaves* 1-foliate, shortly petioled (petiole with petiolule c. 1 cm), subcoriaceous, oblong-elliptic, 15–18 by 6–7 cm; apex distinctly but obtusely acuminate; base broadly rounded; upper surface subolivaceous or subopaque when dry, brown below; nerves c. 7 per side. *Racemes* cauline, solitary, glabrous when old or partly ultimately, shortly, obscurely pubescent, at least 10 cm long. *Flowers* unknown. *Pods* compressed, oblong-elliptic, slightly unequal-sided, 8 by 4 cm, outer surface pale brown and densely shortly pubescent, 2- or 3-seeded.

Distribution — *Malesia*: Philippines (Siargao).

Note — This species is so far only known from the type, one fruiting specimen. It is characterized by the unifoliate leaves with broadly rounded base and the solitary, cauline, racemose infructescence.

7. *Crudia curtisii* Prain

Crudia curtisii Prain, J. As. Soc. Beng. 66, ii (1897) 220, 487; Ann. Roy. Bot. Gard. Calc. 9 (1901) 38, t. 47; Ridley, Fl. Malay Penins. 1 (1922) 640; Whitmore in Tree Fl. Malaya 1 (1972) 249, f. 1 (p.p.) & 3. — Syntypes: *Derry 1164*, Malacca; *Curtis 3007* (K, L photo), Penang; *Kunstler (King's Coll.) 7467 & 4753* (K, L photos) and *8514* (K, L), Malay Peninsula.

Crudia glauca Prain, J. As. Soc. Beng. 66, ii (1897) 221, 487; Ridley, Fl. Malay Penins. 1 (1922) 644; Whitmore in Tree Fl. Malaya 1 (1972) 251. — Type: *Kunstler (King's Coll.) 8157* (K, L photo), Malay Peninsula.

Tree to 21 m high, c. 77 cm in diam.; buttresses equally plank-like, up to 90 cm high. *Stipules* intrapetiolar, minute, c. 2 mm long, puberulous. *Leaves* 6–9- (or 10-)foliolate, distinctly petioled; petiole and rachis up to 10(–18) cm long, puberulous. *Leaflets* chartaceous or membranous, elliptic, elliptic-oblong, ovate to lanceolate, or obovate to oblanceolate, (3.5–)5–10(–16) by (1.5–)2.5–3(–6) cm, the lower ones usually smaller; apex acuminate or acute; base obtuse, rounded, or cuneate, more or less symmetric; glabrous above, glaucous, loosely puberulous (except glabrous on the nerves) beneath; nerves 5–7(–10) per side; petiolules short, 2.5–5 mm, puberulous. *Inflorescences* axillary or terminal, usually erect, up to c. 15(–25) cm long, the rachis greyish puberulous, glabrescent or glabrous, rather loosely flowered; bracts and bracteoles caducous, often hardly found on herbarium specimens; bracteoles subulate, 3–4 mm long; pedicels variable in length (depending on the developing stage of flowers), 6–15(–22) mm, articulated at the base, greyish puberulous. *Flowers* white, easily falling off, greyish puberulous outside. *Hypanthium* c. 1.5 mm long, glabrous inside. *Calyx* lobes unequal, elliptic, broadly elliptic, or suborbiculate, 4–5 by 2–4 mm, glabrous except puberulous at the base inside. *Stamens* 10; filaments (observed from flower buds) c. 2 mm, glabrous; anthers 0.75 mm long. *Pistil* shortly stipitate; stipe c. 1 mm, long, free, glabrous; ovary c. 3 mm long, 2- (or 1-)ovuled; style very short, c. 2 mm, glabrous or slightly hairy at the basal part; stigma indistinguishable. *Pods* broadly ellipsoid, ellipsoid, oblong, or obovoid, 7–12.5 by 5–8 by 1.5 cm, flattened, apex acute or obtuse with a short beak, tapering unequally at base, loosely reticulate, brown, finely velvety, valves thinly leathery, curling up on splitting, 1- (or 2-)seeded. *Seeds* shortly oblong, broadly elliptic, or suborbicular, flat, 3–4 by 2–3.5 by 1.5 cm.

Distribution — *Malesia*: Malaya (widespread but rare).

Habitat & Ecology — In forests of lowland, riverbank, and undulating seasonal swamp, up to c. 300 m altitude. Fl. Feb., March, May, Oct.; fr. Jan., May–July.

Note — The leaf is articulated at the base of the petiole; after falling of the leaf, there is a round or auriculate scar left on a slightly cushion-like thickening of the stem. The flowers are articulated at the bases of their pedicels and they easily fall off. On a herbarium specimen, the flowering shoots sometimes have some open flowers together with flower buds only at their apical parts.

8. *Crudia dewitii* Kosterm.

Crudia dewitii Kosterm., Reinwardtia 6 (1962) 291, f. 9; Verdc., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 99. — Type: *H.J. Lam 854* (K holo; L iso & photo), Irian Jaya, Mamberamo R. *Crudia subsimplicifolia* auct. non Merr.: Merr. & L.M. Perry, J. Arnold Arbor. 23 (1942) 399, based on *Brass* 908 (K, L).

Tree to 30 m high; buttresses straight; branchlets slender, smooth, grey, minutely adpressed hairy. *Stipules* free, narrowly lanceolate, c. 2 mm long. *Leaves* 2- (or 1-)foliolate; petiole very short, slender, glabrous, glossy, 4–15 mm, ending in a subulate tip (c. 3 mm long). *Leaflets* subcoriaceous, elliptic or elliptic-oblong, 7–22.5 by 3–11.5 cm, apex acuminate, base rounded or obtuse; glabrous above, dull and covered with mi-

nute scattered adpressed hairs beneath; nerves 8 or 9 per side; petiolules 3–8 mm, transversally wrinkled. *Inflorescences* in upper axils or terminal on lateral shoots, up to 2.5 cm long, often with many fasciculate, linear, bud scales or bracts, the rachis slightly puberulous; bracts and bracteoles minute, caducous; pedicels very short or almost absent. *Flower* buds very young, c. 2 mm long. *Infructescences* up to 11 cm long. *Pods* brown, often obliquely elliptic-oblong, 7–10 by 3.5–5 cm, compressed, cuneate at both ends, laxly prominulously reticulate, densely ferruginous velvety tomentose and pubescent, the stipe short, c. 3 mm, valves hard leathery, 1- (or 2-)seeded. *Seeds* slightly reniform, c. 3.5 by 5 cm, flat, reddish brown.

Distribution — Solomon Islands (Nggela & Malaita); in *Malesia*: New Guinea (Irian Jaya: Mamberamo R.), Papua New Guinea (Gulf Prov.).

Habitat & Ecology — Lowland or alluvial forest, altitude up to 60 m. Fl. Aug.; fr. Jan., June–Aug. Oct.

Note — The locality of the type collection was cited by Kostermans (l.c.) as “locality not indicated.” From the field note the type was collected by H.J. Lam on 21 August 1920. Its locality is in the region of Mamberamo [Prauwen bivouac, Edi Falls, Van Rees Mts, Meervlakte]. See Fl. Males. I, 1 (1950) 308b].

9. *Crudia evansii* Ridley

Crudia evansii Ridley, J. Fed. Mal. St. Mus. 10 (1920) 133; Fl. Malay Penins. 1 (1922) 645; Whitmore in Tree Fl. Malaya 1 (1972) 251; J.E. Vidal in Fl. Thailand 4 (1984) 89, f. 5, 6. — Type: *Evans s.n.* (K holo; L photo), Malay Peninsula.

Slender *shrub* or *tree*, or *climbing* plant (?), glabrous. *Leaves* 3- or 4-foliolate, petiole and rachis up to 14 cm long, glabrous. *Leaflets* broadly elliptic, 10–20 by 3.5–8 cm, coriaceous, shortly blunt acuminate, base very shortly narrowed; nerves 6–10 per side; petiolules c. 5 mm long. *Inflorescences* axillary, racemose, up to c. 5 cm long, the rachis scurfy-velvety, brownish; pedicels very short, 1–2 mm, velvety. *Calyx* lobes c. 4 mm long, velvety. *Stamens* 10, glabrous. *Ovary* 6-ovuled. *Pods* elliptic, 6–10 by 3.5–4 cm, acute at the apex, unequally rounded at the base, transversally veined, rusty-velvety. *Seeds* 1 or 2, reniform, 3–4 by 2–3 cm, brown.

Distribution — Thailand (Peninsular); in *Malesia*: Malay Peninsula (Pahang).

Habitat & Ecology — On limestone hill and in rain forest. Fl. June; fr. Jan., May.

Note — On the field label of the type specimen this was distinctly recorded as ‘climbing plant’ by the collector J.H.N. Evans.

10. *Crudia gracilis* Prain

Crudia gracilis Prain, J. As. Soc. Beng. 66, ii (1897) 223, 488; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 423; Whitmore in Tree Fl. Malaya 1 (1972) 251; J.E. Vidal in Fl. Thailand 4 (1984) 89. — Type: *Kunstler* (= *King's Coll.*) 8468 (K, L photo), Malay Peninsula.

Crudia brevipes Ridley, J. Str. Br. Roy. As. Soc. 82 (1920) 183; Fl. Malay Penins. 1 (1922) 645; Whitmore in Tree Fl. Malaya 1 (1972) 249. — Type: *Ridley* 12623 (erron. cited as 12653) (K holo; L photo), Malay Peninsula.

Slender *shrub* to 2.4 m high, or *tree* 5–25 m high. *Stipules* minute. *Leaves* (1-, 2- or 3-foliolate, petiole and rachis 1–3 cm long, glabrous. *Leaflets* chartaceous, elliptic-oblong to elliptic-lanceolate, 7–18 by 2–9 cm, pale yellowish green, glabrous on both surfaces; apex acuminate or cuspidate; base cuneate or slightly unequally rounded; nerves c. 6 per side; petiolules very short, c. 5 mm. *Inflorescences* axillary, at the ends of new leafy shoots, 8–15(–30) cm long, pendulous, loosely flowered, the rachis glabrous, bracteoles minute; pedicels very short or almost invisible. *Hypanthium* obscure. *Calyx* lobes oblong, c. 4 mm long, glabrous on both surfaces. *Stamens* 8 or 9; filaments free, glabrous, alternately shorter and longer; anthers broadly ovoid. *Pistil* shortly stipitate; ovary 1–3-ovuled. *Pods* unknown.

Distribution — Thailand (Peninsular); in *Malesia*: Malay Peninsula (Perak, Wellesley, Johore).

Habitat & Ecology — In dense forest in swampy ground at low altitudes. Fl. Feb., March.

11. *Crudia katikii* Verdc.

Crudia katikii Verdc., Kew Bull. 32 (1978) 470; Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 100. — Type: *Katik NGF 46520* (BRI holo; L), Papua New Guinea.

Tree to 21 m high and 75 cm in diam. *Leaves* 2- or 3-foliolate, petiole up to 2(–3) cm. *Leaflets* elliptic-oblong, 6.5–17 by 2.8–8.5 cm, chartaceous; apex narrowly acuminate; base very broadly cuneate; glabrous above, excessively finely puberulous beneath. *Inflorescences* 5–7 cm long, the rachis rather sparsely pubescent; pedicels 5–6 mm. *Hypanthium* c. 2 mm long. *Calyx* lobes 4.5 by 2.5 mm, finely pubescent outside. *Stamens* 10, the filaments strongly bent in bud. *Ovary* 4-ovuled. *Pods* (immature) elliptic-oblong, c. 8 by 4 cm, very compressed, finely rugulose, densely pubescent, the stipe c. 5 mm long.

Distribution — *Malesia*: Papua New Guinea (Madang).

Habitat & Ecology — Lowland rain forest, altitude 30–60 m. Fl. and fr. Sept., Oct.

12. *Crudia lanceolata* Ridley

Crudia lanceolata Ridley, J. Str. Br. Roy. As. Soc. 75 (1917) 29; Whitmore in Tree Fl. Malaya 1 (1972) 251; J.E. Vidal in Fl. Thailand 4 (1984) 92, f. 23/4. — Type: (*Herb.*) Ridley (Coll. Haniff or Aniff) 15539 (K holo; L photo), Langkawi I.

Crudia curtisii auct. non Prain: Ridley, J. Str. Br. As. Soc. 59 (1911) 99, based on Haniff's collection cited above.

Tree 10.5–20 m high. *Stipules* intrapetiolar, c. 3 mm long. *Leaves* (2-) 3- or 4-foliolate, shortly petioled; petiole and rachis (1.5–)3–5(–9) cm long, glabrous. *Leaflets* chartaceous or subcoriaceous, elliptic, elliptic-lanceolate, ovate- or obovate-elliptic, 6–14.5 by 3–4.5 cm, the lower ones usually smaller; apex acuminate or caudate; base obtuse or cuneate, more or less symmetric; glabrous, sometimes sparsely puberulous usually on the midrib beneath when young; nerves 6–10 per side; petiolules short, 2–5 mm, glabrous. *Inflorescences* terminal or axillary, solitary or rarely 2 in an axil, pendulous, up

to 22 cm long, puberulous, rather loosely flowered; bracts up to c. 3 mm long, some of them 3-lobed and the middle lobe pinnately relobed with 1 terminal and 2 pairs of side lobelets; bracteoles minute, triangular, c. 0.3 mm long; pedicels 2–6 mm, articulated at the base, sparsely puberulous. *Flowers* easily falling off, sparsely puberulous, glabrescent, or almost glabrous outside. *Hypanthium* c. 1 mm long, glabrous inside. *Calyx* lobes unequal, broadly ovate or suborbiculate, 3–4 by 2.5–3 mm, glabrous inside. *Stamens* 10; filaments (observed from flower buds or young flowers) 2–5 mm, glabrous; anthers c. 1 mm long. *Pistil* shortly stipitate; stipe c. 1 mm long, free, glabrous; ovary c. 2 mm long, 4- (or 5-) ovuled; style c. 3 mm, glabrous; stigma obscure, slightly thicker than the style. *Pods* broadly elliptic, 6 by 4–4.5 cm, with a short beak c. 7 mm long, brownish hairy, 1- (or 2-) seeded. *Seeds* suborbiculate, c. 2.5 cm across.

Distribution — Thailand (Peninsula); in *Malesia*: Malaya (Langkawi I., Selangor, Johore).

Habitat & Ecology — In forest, ridge top and hillside, up to 150(–400) m altitude. Fl. March–Dec.; fr. Feb.–Nov.

Note — The type of *Crudia lanceolata* Ridley was collected by Mohamed Haniff (or Aniff) from Langkawi and was cited in the protologue without the collector's number. I examined the type in K, which is numbered '15539' in Ridley's handwriting, and was previously named and reported by him (1911) as *Crudia curtisii* Prain. This rather high collection number is treated here as belonging to (Herb.) Ridley or his series.

13. *Crudia mutabilis* de Wit

Crudia mutabilis de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 424. — Type: *Dorst* (*For. Res. Stat.*) 1-PT-763 (BO holo; L), Sumatra.

Tree 15–24 m high. *Stipules* free, interpetiolar, falcate, up to 7.5 mm long, subglabrous, caducous. *Leaves* (4-) 5- or 6-foliolate, shortly petioled; petiole and rachis 6.5–14.5(–16.5) cm long, glabrous, prolonged beyond the upper petiolule into a subulate, caducous part, often leaving a minute tip. *Leaflets* more or less coriaceous, elliptic, obovate-elliptic, or ovate, (6.3–)13.5–23.5 by (3.2–)5–7.9 cm, the lower ones usually smaller; apex shortly acuminate or caudate; base cuneate, subacute, obtuse, or rounded, symmetric; glabrous; nerves 4–7 per side; petiolules short, 4–9 mm, glabrous. *Inflorescences* axillary, 8–16(–60) cm long, pendulous, the rachis minutely puberulous, glabrescent, loosely flowered; bracts ovate, c. 3 mm long, or 3-lobed and the central lobe relobed with 3–6 needle-like segments, glabrous; bracteoles minute, c. 0.6 mm long; pedicels 6–14 mm, articulated at the base, minutely, sparsely puberulous. *Flowers* sparsely puberulous outside. *Hypanthium* c. 1 mm long, glabrous inside. *Calyx* lobes unequal, broadly elliptic or ovate, or orbiculate, 5–7 by 3.5–5 mm, glabrous inside. *Stamens* 10; filaments up to c. 18 mm, glabrous; anthers c. 1 mm long. *Pistil* shortly stipitate; stipe c. 1 mm, free, glabrous; ovary c. 4 mm long, densely brown hairy, 4- or 5-ovuled; style up to c. 15 mm, glabrous except sparsely hairy towards the base; stigma obscure, slightly thicker than the style. *Pods* (fide de Wit l.c.) obliquely obovate, c. 11 by 5–6 cm, with stout veins and heavy, raised sutures, beaked, flat, puberulous.

Distribution — *Malesia*: Sumatra (Palembang), Java (Priangan).

Habitat & Ecology — In forest on not inundated sandy soil in flat country, c. 15 m altitude. Fl. April; fr. May.

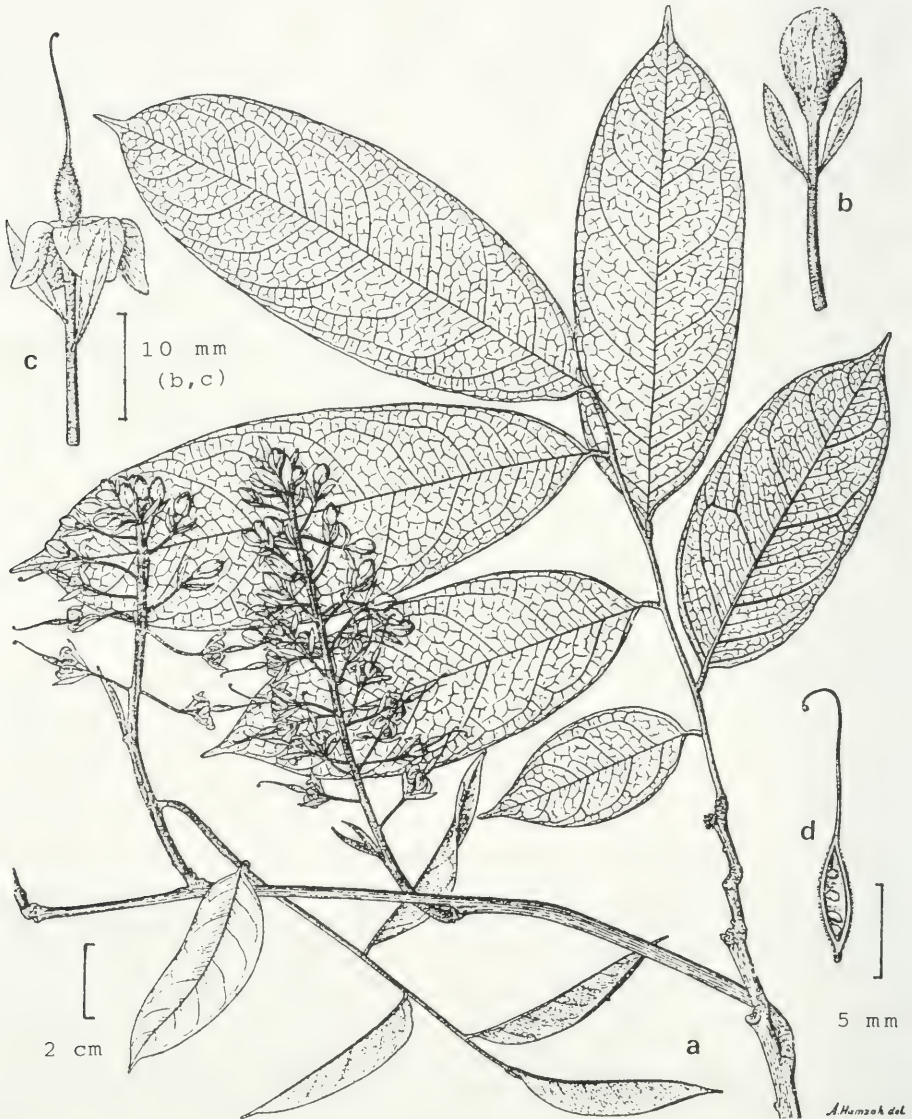


Fig. 27. *Crudia ornata* de Wit. a. Flowering branch; b. flower bud with bracteoles; c. flower, stamens removed; d. pistil, with longitudinal section of ovary (Elmer 20708). Reproduced from Bull. Bot. Gard. Buitenzorg III, 18.

14. *Crudia ornata* de Wit

Crudia ornata de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 425, f. 3; Cockb., Trees Sabah 1 (1976) 160. — Type: *Elmer 20708* (BO holo; BM, K, L), Sabah.

Crudia reticulata auct. non Merr.: Merr., Pl. Elmer. Born. (1929) 99, based on *Elmer 20708*.

Tree to 10(–21) m high and 7.6(–28.6) cm in diam., shrub-like tree or treelet 1.5 m high. *Stipules* intrapetiolar, 2–3 mm long. *Leaves* (4–)5 or 6(–8)-foliolate, shortly petioled; petiole and rachis (6–)9–14 cm long, minutely puberulous, prolonged beyond the upper petiolule into a caducous process, often only the scar seen on a specimen. *Leaflets* subcoriaceous, elliptic-, obovate- or ovate-oblong, or elliptic, (7.5–)14–20 by (3.5–)4.8–7.5 cm, the lower ones usually smaller; apex cuspidate or rather abruptly acuminate; base cuneate, acute, obtuse, or rounded, symmetric; glabrous above, loosely minutely puberulous, glabrescent, or glabrous beneath; nerves 5–8 per side; petiolules short, 5–9 mm, subglabrous. *Inflorescences* axillary, sometimes also terminal, up to 15.5 cm long, erect, the rachis rusty-tomentose, moderately flowered; bracts ovate, lanceolate, or linear, 3.5–15 mm long, puberulous, glabrescent; bracteoles elliptic, lanceolate, or oblanceolate, often at the upper half of the pedicel, rather large, covering the bud at its very young stage, 6–8 mm long; pedicels 15–20 mm, puberulous, articulated at the base. *Flowers* puberulous outside. *Hypanthium* 2–3 mm long, often ridged outside, glabrous inside. *Calyx* lobes unequal, broadly elliptic or elliptic, or obovate, 6–7 by 3–4 mm, slightly loosely appressedly puberulous often on the lower half inside, glabrescent, or almost glabrous. *Stamens* 10 (or 9); filaments up to c. 15 mm, glabrous; anthers c. 1 mm long. *Pistil* stipitate; stipe 2–3 mm long, glabrous; ovary 3–4.5 mm long, (4–)6-ovuled; the style up to c. 8 mm, glabrous except often hairy towards the base; stigma obscure, slightly thicker than the style. *Pods* oblong, elliptic, or oblanceolate, often unequilateral, 10–14 by 4.5–5 cm, acuminate and hardly beaked at apex, obtuse at base, shortly brown hairy, valves 2, hard leathery, 1–several-seeded. *Seeds* irregularly suborbicular or subreniform, 2.5–3 by 3.5–4 by 1.7 cm, slightly finely rugose. — **Fig. 27.**

Distribution — *Malesia*: Borneo (Sabah, Sarawak, Kalimantan).

Habitat & Ecology — In primary forests, from lowland up to 200 m altitude, sometimes occurring on sand- and limestone. Fl. Jan., Feb., April, July, Aug., Oct., Nov.; fr. April, July, Aug.

Notes — 1. The habit of the plants of *Crudia ornata* has variously been recorded as a tree (often), a treelet (e.g., *SAN 67706*, L), a slender shrub-like tree (Merrill l.c.), or a shrub (e.g., *Valera 9442*, L).

2. Specimens of the present species can be recognized by a combination of the following characters: 1) leaves often 5- or 6-foliolate, 2) leaflets coriaceous, often loosely minutely puberulous on the lower surface, 3) nerves and veins obscure or invisible above, obscure, visible or distinct beneath, 4) pedicels, rather long in this genus, 15–20 mm, 5) rather large bracteoles (6–8 mm long), 6) calyx lobes often slightly loosely appressedly puberulous on the lower half inside, and 7) ovary often 6-ovuled.

15. *Crudia papuana* Kosterm.

Crudia papuana Kosterm., Reinwardtia 6 (1962) 292, f. 10; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 100, f. 22. — Type: McVeagh NGF 8275 (K holo; L iso & photo), Papua New Guinea.

Tree 12–24 m high and 35–50 cm in diam.; buttresses thick, steep, to c. 1 m high. *Stipules* minute, caducous. *Leaves* usually with 2 opposite leaflets, or sometimes 1-foliate, petiole 4–11 mm, glabrous, glossy, ending in a subulate tip (c. 4 mm long). *Leaflets* subcoriaceous, elliptic, oblong, or slightly obovate-oblong, 6–21.5 by 2–7.5 cm, apex bluntly acute to acuminate, base rounded or obtuse; rather shining and glabrous on both surfaces; nerves 5–9 or more per side; petiolules rather thick, 4–12 mm, transversally wrinkled. *Inflorescences* in upper axils or terminal on lateral shoots, up to c. 15 cm long, moderately flowered, often with many fasciculate, linear bud scales or bracts at the base, the rachis glabrous, sometimes sparsely puberulous; bracts and bracteoles minute, triangular, 0.5–1.5 mm long; pedicels short, 2–3 mm, glabrous. *Flowers* cream white or very pale green, scented. *Hypanthium* obscure. *Calyx* lobes ovate, c. 4 by 2 mm, glabrous. *Stamens* 10, c. 5 mm, glabrous. *Pistil* distinctly stipitate; ovary c. 2.5 mm long, 2-ovuled; style c. 2.5 mm, glabrous; stigma obscure. *Pods* brownish black when ripe, often obliquely elliptic or elliptic-oblong, 9–11 by 4–7 cm, compressed, apex acute or shortly acuminate, base rounded or obtuse, or sometimes slightly cuncate, laxly prominulously reticulate, densely ferruginous velvety tomentose and pubescent, the stipe short, c. 3 mm, valves leathery, 1- (or 2-)seeded. *Seeds* slightly reniform, 3–5 by 5–7.5 cm, flat, reddish brown.

Distribution — Solomon Islands (New Georgia); in *Malesia*: New Guinea (Irian Jaya: Asmat region; Papua New Guinea: Western & Gulf Provinces).

Habitat & Ecology — Riverbank, sago swamp-woodland, swamp forest, land subject to tidal (fresh water) inundation. 0–114 m altitude. Fl. Feb., March, June, July; fr. Jan., May, July.

Note — This species is characterized by the mostly 2-foliate leaves. The leaflets are coriaceous, glabrous and with transversally wrinkled petiolule, and are opposite on a 2-foliate leaf. The pods are often 1-seeded.

16. *Crudia penduliflora* Ridley

Crudia penduliflora Ridley, J. Str. Br. Roy. As. Soc. 61 (1912) 3; Fl. Malay Penins. 1 (1922) 645; Whitmore in Tree Fl. Malaya 1 (1972) 251. — Type: Ridley 3004 (K holo; L photo), Malay Peninsula.

Tree. *Leaves* 4-foliate, shortly petioled, petiole and rachis 3.5–7 cm long. *Leaflets* thinly coriaceous, alternate, elliptic, 2.5–8.5 by c. 4 cm, lowest ones smallest, apex cuspidate with a long cusp c. 1.5 cm long, base obtuse or rounded, drying brown and glabrous on both surfaces; nerves c. 6 per side; petiolule c. 3 mm, glabrous. *Inflorescences* axillary, pendulous, 30 cm long, with numerous, rather small flowers; pedicels very short, c. 1.5 mm. *Calyx* lobes ovate, glabrous. *Stamens* 5, filaments slender, anthers ellipsoid. *Ovary* conic, hairy; style filiform, 3–5 mm. *Pods* unknown.

Distribution — *Malesia*: Malay Peninsula (Malacca: Mt Ophir).

Habitat & Ecology — Foot of mountain. Fl. June.

Note — This species is only known from the type. It can be easily recognized by its simple, rather long racemose inflorescence with small flowers.

17. *Crudia reticulata* Merr.

Crudia reticulata Merr., Philipp. J. Sc., Bot. 13 (1918) 73; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 426, emend.; Cockb., Trees Sabah 1 (1976) 160, f. 33 upper left. — Type: *Villamil 393* (K iso; L photo), Sabah.

Treelet 5–9 m high and 7–15 cm in diam., or *tree* to 18 m high and 20 cm in diam., sometimes *shrub*-like (1–)3–4 m high, rarely a *climber* (?). *Stipules* intrapetiolar, falcate, 5–6 mm long, caducous. *Leaves* (1–) 2- or 3- (4-)foliolate, shortly petioled; petiole and rachis 0.5–2(–4) cm long, prolonged beyond the upper petiolule into a subulate tip c. 5 mm. *Leaflets* firmly chartaceous, elliptic or elliptic-, ovate- or obovate-oblong, 10–29(–36) by 3–8(–12.5) cm, apex acuminate or rather abruptly caudate-acuminate, the acumen slender, 1.5–2.5(–3.5) cm long; base cuneate, acute, obtuse, or rounded, symmetric or slightly unsymmetric; glabrous or rarely sparsely minutely hairy below; nerves 5–9 (or more) per side; petiolules short, 3–7 mm, glabrous. *Inflorescences* axillary, up to c. 10(–28) cm long, the rachis puberulous, moderately flowered; bracts subulate and long-drawn, or 3-lobed with the central lobe relobed and bristle-like, slightly hairy, up to c. 8 mm long, sometimes many, aggregate, surrounding the base of the peduncle and brush-like, (semi-)persistent, puberulous outside, slightly ciliate on the margins, those at the base of pedicels rather small, triangular, 0.3–1.5 mm long; bracteoles minute, triangular, c. 0.5 mm long; pedicels 3–5(–8) mm, articulated at the base, puberulous. *Flowers* puberulous outside, glabrous inside. *Hypanthium* c. 1 mm long. *Calyx* lobes ovate or broadly ovate, 3.5–4 by 2–2.5 mm, with 3(–5) longitudinal veins. *Stamens* (8–)10; filaments 4–6 mm (or longer); anthers ellipsoid, c. 0.8 mm long. *Pistil* stipitate; stipe free, c. 1 mm long, slightly puberulous; ovary c. 2 mm long, (3- or) 4(–6)-ovuled; style 4.5–5.5(–10) mm, glabrous except slightly hairy towards the base; stigma obscure. *Pods* (young) ellipsoid or ovoid 8.5–12.5 by 3–4 cm, apex shortly acuminate, not beaked, base rounded or acute, densely shortly brown hairy. *Seeds* broadly ellipsoid or suborbicular, 2.6–3.3 by 2–2.4 cm, c. 1.2 cm thick, testa rusty scurfy, finely rugose.

Distribution — *Malesia*: Borneo (Sabah, Sarawak, Kalimantan).

Habitat & Ecology — Lowland primary forest, dipterocarp forest, marshy, periodically inundated, seasonal or peat swamp, sandy soil, moderately drained ground, loam soil with coral limestone, sometimes found in secondary forest, to 96(–250) m altitude, once recorded from 1000 m (Berau). Fl. Jan.–April, July–Sept.; fr. April, June–Nov.

Note — 1. In *Crudia reticulata* the nerves on the upper surface of the leaflets are often in slightly shallow grooves, horizontal or oblique and the distal ends joining together in a series of prominent arches up to c. 10 mm from the margin. The basal bracts of the peduncle are rather long (up to c. 8 mm), sometimes many, aggregate, (semi-)persistent,

surrounding the base and bush-like. This kind of bracts is very characteristic for the present species.

2. There is one collection (SAN 49887, K, L) which was recorded as a "woody climber clinging on an obah (i.e. *Eugenia*) tree."

18. *Crudia ripicola* de Wit

Crudia ripicola de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 428. — Type: *Ender* 2024 (BO holo; K, L), Kalimantan.

Tree 15–20 m high and 20–60 cm in diam. *Stipules* intrapetiolar, 3–4 mm long, deciduous. *Leaves* 5- or 6(–8)-foliolate, petioled; petiole and rachis 6–14 cm long, prolonged beyond the upper petiolule into a short, caducous process (c. 2 mm long), often only the lower part or scar seen on a specimen. *Leaflets* firmly chartaceous or subcoriaceous, elliptic-, obovate- or ovate-oblong, 10–18(–21) by 3–6(–8) cm, the lower ones usually smaller; apex acuminate or rather abruptly acuminate; base cuneate, acute, obtuse, or rounded, symmetric or unsymmetric; glabrous, often glossy above, loosely minutely, appressedly puberulous, slightly to prominently glaucous beneath; nerves 5–8 per side; petiolules short, 4–9 mm, slightly puberulous. *Inflorescences* axillary, up to 31 cm long, pendulous, the rachis minutely puberulous, abundantly flowered; bracts triangular, 1.5–4.5 mm long, puberulous or subglabrous; bracteoles ovate, 1–1.5 mm long; pedicels 4–7 mm, articulated at the base, puberulous. *Flowers* yellowish green, puberulous outside. *Hypanthium* c. 1 mm long, glabrous inside. *Calyx* lobes elliptic, c. 6 by 3 mm, glabrous inside. *Stamens* 10; filaments up to c. 10 mm, glabrous; anthers c. 1 mm long. *Pistil* stipitate; stipe free, c. 2 mm long, densely hairy often at the upper half, glabrous at about the lower half; ovary c. 5 mm long, 4-ovuled; style up to c. 12 mm, glabrous except often hairy towards the base; stigma obscure, slightly thicker than the style. *Pods* (young) slightly obliquely oblong, 6.5–10 by 3.5–5 cm, flat, not beaked, almost obliquely truncate at the base, shortly brown hairy. *Seeds* very young (one pod with only one seed and 3 undeveloped ovules).

Distribution — *Malesia*: Borneo (Kalimantan).

Habitat & Ecology — In forests rather common on low riverbanks, or occurring in small groups in the forest on temporarily inundated grounds, up to c. 15 m altitude. Fl. June; fr. June, July.

19. *Crudia scortechinii* Prain

Crudia scortechinii Prain, J. As. Soc. Beng. 66, ii (1897) 220, 488; Ridley, Fl. Malay Penins. 1 (1922) 644; Whitmore in Tree Fl. Malaya 1 (1972) 252, f. 3 lower left, only one leaflet. — Type: *Scortechinii* 2029 (erron. as 2129) (K holo; L photo), Malay Peninsula.

Tree 24–27(–36) m high; young branches tawny pubescent; buttresses to 1.8 m high. *Stipules* interpetiolar, c. 2.5 mm long. *Leaves* 9–13-foliolate; petiole and rachis 17–24 cm long. *Leaflets* chartaceous, lanceolate, 5–7.5 by 2.5 cm; apex acuminate; base slightly unequally rounded; green and glabrous above, paler and pubescent beneath; nerves

12–16 per side. *Inflorescences* axillary, at the ends and bases of new leafy shoots, 7.5–15 cm long, the rachis angular, pubescent; bracts and bracteoles minute, the bracteoles often at the middle of the pedicels; pedicels variable in length, 6–15 mm, puberulous. *Hypanthium* c. 1.5 mm long, puberulous outside. *Calyx* lobes elliptic or suborbicular, 4–5 by 2–4 mm, puberulous outside, sometimes also on the basal part inside. *Stamens* 10, rarely 9, alternately shorter and longer. *Pistil* shortly stipitate; ovary c. 3 mm long, 1- or 2-ovuled; style short, c. 2 mm, glabrous except the basal part; stigma obscure. *Pods* shortly oblong, c. 3.5 by 6 cm, flat, woody, obliquely rounded at both ends, rugose, densely rusty hairy. *Seed* often 1.

Distribution — *Malesia*: Malay Peninsula (Perak).

Habitat & Ecology — In forest. Fr. Dec.

Note — There are four specimens with the name of *Crudia scortechinii* Prain in the author's handwriting in K: two in flower and two in fruit, respectively. They all match the original description and may all be considered as the authentic material of this species. When Prain published the species, he cited (l.c.: 220) only one collection: *Scortechini* 2129, later (l.c.: 488) rightly corrected to 2029.

20. *Crudia sparei* Whitmore

Crudia sparei Whitmore, Gard. Bull. Sing. 24 (1969) 4; in Tree Fl. Malaya 1 (1972) 252. — Type: (G.H. Spare) SF 34494 (KEP holo; K, L), Malay Peninsula.

Climber. *Stipules* intrapetiolar, c. 1.5 mm long, caducous. *Leaves* 2- or 3-foliolate; petiole and rachis 1.5–2 cm long, glabrous. *Leaflets* subcoriaceous, elliptic, rarely ovate- or obovate-elliptic, 5–12(–14) by 2.5–4.5(–6) cm, the lower ones usually smaller; apex shortly acuminate; base obtuse, or cuneate, more or less symmetric; glabrous above, loosely minutely puberulous beneath; nerves 5–8 per side; petiolules short, 3–5 mm, glabrous. *Inflorescences* terminal or axillary, pendulous or curved, up to 55 cm long, the rachis glabrous, rather loosely flowered; bracts oblong, c. 7 mm long, 3-lobed at the upper 2 mm; the central lobe longitudinally relobed with 4 parallel lobules; bracteoles at the base of the flower, minute, triangular, c. 0.5 mm long, persistent; pedicels very short, c. 1.5 mm, articulated at the apex. *Flowers* easily falling off, sparsely puberulous (on the uncovered part of the calyx lobes) outside. *Hypanthium* c. 1 mm long, glabrous inside. *Calyx* lobes unequal, ovate or ovate-oblong, 3–4 by 2–3 mm, glabrous inside. *Stamens* 10; filaments (observed from flower buds) c. 5 mm, glabrous; anthers 0.75 mm long. *Pistil* shortly stipitate; stipe c. 1 mm long, free, glabrous; ovary c. 2 mm long, 2-ovuled; style 10–12 mm, glabrous; stigma obscure, slightly thicker than the style. *Pods* unknown.

Distribution — *Malesia*: Malay Peninsula (Perak). Only known from the type.

Habitat & Ecology — Riverside. Fl. Jan.

21. *Crudia splendens* de Wit

Crudia splendens de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 429. — Type: *Teijsmann s.n.* (BO, not seen), Kalimantan.

Stipules free, interpetiolar, foliaceous, auriculate-falcate, glabrous, acute, reticulate, 9 by 5 mm. *Leaves* 4- or 5-foliolate; rachis 6–8 cm long. *Leaflets* coriaceous, obovate-oblong, elliptic-oblong, or ovate-oblong, 10–17 by 5–7 cm; apex subacute to brief, blunt-acuminate; base rounded or obtuse; entirely glabrous; nerves 6 or 7 per side. *Flowers* unknown, apparently loosely arranged along a sturdy, glabrous, striate axis exceeding 10 cm in length. *Pods* (*calyx* persistent, glabrous) large, flat, subligneous, 5-ovulate, elliptic to elliptic obovate, up to 15 by 6–7 cm, brown-velvety, veined, with thick, raised sutures, shortly beaked. *Seeds* irregularly orbicular, flattened, 4.5 cm across.

Distribution — *Malesia*: Kalimantan.

Note — This species is only known from the type, which I have not seen. The specific description given above is based on the original one. The foliaceous, auriculate-falcate, rather large stipules are very characteristic for the present species.

22. *Crudia subsimplicifolia* Merr.

Crudia subsimplicifolia Merr., Philipp. J. Sc., Bot. 5 (1910) 39; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 431. — Type: Klemme FB 4287 (K iso; L photo), Luzon.

Tree to 15 m high and c. 38 cm in diam. *Stipules* intrapetiolar, c. 3.5 mm long, caducous. *Leaves* 1- or 2-foliolate, when 2 then often not opposite, very shortly petioled; petiole and rachis up to c. 10 mm long, prolonged beyond the upper petiolule into a subulate tip c. 2 mm long. *Leaflets* firmly chartaceous, elliptic, elliptic- or obovate-oblong, or lanceolate, 9.5–21(–29) by 3.5–7(–9) cm, apex (shortly) acuminate; base acute or obtuse, symmetric; glabrous or rarely sparsely minutely hairy below; nerves 6–9 per side; petiolules short, 2–3.5 mm, glabrous. *Inflorescences* axillary or sometimes terminal, up to c. 11(–16) cm long, glabrous, rather loosely flowered; bracts of the peduncle triangular, or 3-lobed with the central lobe relobed and bristle-like, up to c. 5 mm long, glabrous except ciliate at the margins; bracteoles often at the lower half or at the base of the pedicel, minute, triangular, 0.75–1 mm long; pedicels 2–4(–9) mm, articulate at the base, glabrous. *Flowers* glabrous outside except ciliate at the margin of the calyx lobes, white or yellowish white. *Hypanthium* c. 1 mm long, sometimes slightly longitudinally ridged outside, sparsely hairy inside. *Calyx* lobes ovate or broadly elliptic, c. 4 by 2.5–3 mm, glabrous inside. *Stamens* 10; filaments 4–6 mm (or longer); anthers c. 0.75 mm long. *Pistil* stipitate; stipe free, 0.75–1 mm long, puberulous; ovary c. 3.5 mm long, 3- or 4-ovuled; style up to c. 10 mm, often slightly hairy at lower half; stigma slightly thicker than the style. *Pods* (very young) elliptic, 5.5 by 3 mm.

Distribution — *Malesia*: Borneo (Sabah, Sarawak), Philippines (Luzon), Aru Islands.

Habitat & Ecology — Primary and dipterocarp forests, hill ridge, low undulating area, or near the river, altitude up to 300(–900) m. Fl. Jan.–April, June, Oct.; fr. April.

Note — *Crudia subsimplicifolia* is closely allied to *C. reticulata*. It can be easily recognized by the 1- or 2-foliolate leaves, usually glabrous on both surfaces, nerves flat above, and inflorescences with glabrous peduncles, rachides, pedicels and flowers (except shortly ciliate at the calyx margins).

23. *Crudia tenuipes* Merr.

Crudia tenuipes Merr., Philipp. J. Sc., Bot. 11 (1916) 83; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 430; Cockb., Trees Sabah 1 (1976) 160, f. 33 lower left. — Type: *Native Collector BS 1358* (erron. as 1385) (K iso, sub no. 1358; L photo), Sarawak.

Tree to 27 m high and 38(–50) cm in diam.; buttresses steep, 1.5 m high and 30 cm extending outwards from the base. *Stipules* intrapetiolar, minute, c. 1 mm long, caducous. *Leaves* 2–4-foliolate, shortly petioled; petiole and rachis 1.5–7 cm long, not prolonged beyond the upper petiolule. *Leaflets* firmly chartaceous, elliptic- or ovate-oblong, 7–20 by 3–7 cm, the lower ones usually smaller; apex acuminate or rather abruptly acuminate; base cuneate, acute, obtuse, or rounded, symmetric or slightly unsymmetric; glabrous; nerves 5–7 per side; petiolules short, c. 5 mm, glabrous. *Inflorescences* axillary, up to 24 cm long, glabrous, loosely flowered; bracts triangular, up to c. 1.5 mm long, glabrous, caducous; bracteoles sparsely alternate at the lower half, or subopposite or opposite at the base, of the pedicel, triangular, minute, c. 0.2 mm long, glabrous, caducous; pedicels (7–)15–22(–30) mm, articulated at the base, glabrous. *Flowers* greenish white, greenish yellow, or white, scented, glabrous outside. *Hypanthium* c. 2 mm long. *Calyx* lobes elliptic or ovate-oblong, 4–4.5 by 2–2.5 mm, the inner surface often puberulous on the longitudinal, central part, glabrescent, sometimes almost glabrous on some of the flowers. *Stamens* (8–)10; filaments up to c. 12 mm, glabrous; anthers 0.7–1 mm long. *Pistil* stipitate; stipe free, c. 1.5 mm long, glabrous; ovary c. 3 mm long, (2–) 4- (or 5-)ovuled; style up to c. 14 mm, glabrous except often hairy towards the base; stigma obscure, slightly thicker than the style. *Pods* ellipsoid or fusiform, 5–8 by 2.5–3.5 cm, swollen, 1.8–2.5 cm thick, gradually narrowed from the middle towards both ends, or beaked at apex and obtuse at base, shortly brown hairy, valves 2, coriaceous, hard, 1- or 2- (or more-)seeded. *Seeds* transverse-oblong or slightly reniform, 2–2.2 by 3–3.7(–4.7) cm, slightly swollen, 1.8–2.3 cm, thick, smooth, shining.

Distribution — *Malesia*: Borneo (Brunei, Sabah, Sarawak, Kalimantan).

Habitat & Ecology — Widespread in forests; sometimes found on limestone, coral limestone rock, sandy yellow loam. Up to 540 m altitude. Fl. Jan.–May, Oct., Nov.; fr. April, May, July–Sept., Dec.

Note — *Crudia tenuipes* is characterized by the following characters: 1) Leaves 2–4-foliolate with glabrous leaflets, 2) pedicels rather long, usually 15–22 mm, 3) calyx lobes often puberulous on the inner surface, glabrescent, and 4) pods ellipsoid or fusiform, swollen, 5–8 by 2.5–3.5 by 1.8–2.5 cm; sometimes remains of calyx lobes which are sparsely hairy on the inner surface can be observed with a handlens of $\times 10$.

24. *Crudia teysmannii* de Wit

Crudia teysmannii de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 431. — Type: *Teijsmann 8317* (BO holotype), Kalimantan.

Tree to 20 m high and 80 cm in diam. *Stipules* intrapetiolar, 1.5–2 mm long, deciduous. *Leaves* (1- or) 2–4- (or 5-)foliolate, shortly petioled; petiole and rachis 1.5–4.5

cm long, glabrous, prolonged beyond the upper petiolule into a short, subulate tip. *Leaflets* subcoriaceous or coriaceous, elliptic-oblong, ovate to lanceolate, or obovate-elliptic, 7–10.5(–16.5) by 2.5–3.5(–7) cm; apex shortly acuminate or acuminate; base cuneate, obtuse, or rounded, often symmetric; glabrous and often shining above, dull, loosely minutely, appressedly puberulous, usually glaucous beneath; nerves 5–7 per side; petiolules short, 1.5–6 mm, almost glabrous. *Inflorescences* axillary or terminal, up to 16 cm long, often erect, sometimes nodding, the rachis minutely puberulous; bracts ovate, 1–1.5 mm long, puberulous outside; bracteoles at the upper half of the pedicel, ovate, c. 1 mm long; pedicels 2–5 mm, articulated at the base, minutely puberulous. *Flowers* thinly, minutely, appressedly puberulous outside. *Hypanthium* c. 1.5 mm long, striate. *Calyx* lobes broadly elliptic or suborbicular, 3–4 mm long, puberulous outside, glabrous inside. *Stamens* (7–)8–10; filaments 6–8 mm; anthers ellipsoid, c. 1 mm long. *Pistil* stipitate; stipe free, 1–1.5 mm long, glabrous; ovary 2–3 mm long, (3- or) 4-ovuled; style incurved, 3.5–6 mm, glabrous; stigma obscure. *Pods* elliptic, oblong-elliptic, or broadly elliptic-ovate, 5.5–16.5 by 3.5–5.5 cm, flat, apex acute or obtuse, hardly beaked, acute or rounded at the base, loosely reticulately veined, densely shortly brown hairy, 2–4-seeded. *Seeds*: young ones suborbicular, flat, 8–12 mm in diam.; ripe ones up to over 5 cm in diam. (fide de Wit l.c.).

Distribution — *Malesia*: Sumatra (Palembang), Borneo (Kalimantan).

Habitat & Ecology — In forests growing on swampy places, seasonally or continuously inundated grounds along riverbanks, sometimes also occurring in secondary forests of sandstone slopes, rather common locally, up to 35 m altitude. Fl. April, Oct.; fr. July, Aug., Oct.

Uses — De Wit (l.c.) recorded that the fruits are cut and boiled, to serve as a bait for fishing 'djelawat' (a small freshwater fish). It was once reported to be a 'bee-tree'.

25. *Crudia velutina* Ridley

Crudia velutina Ridley, Kew Bull. (1929) 257; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 432; Whitmore in Tree Fl. Malaya 1 (1972) 252, f. 4. — Type: *Haviland 3071* (K holo; BM, L), Sarawak.

Tree to 30 m high and 66 cm in diam.; buttresses to c. 2.4 m high. *Stipules* intrapetiolar, subulate, 2–3 mm long, deciduous. *Leaves* 2- or 3- (or 4-)foliolate, shortly petioled; petiole and rachis c. 1 cm long, brown puberulous, glabrescent, prolonged beyond the upper petiolule into a very short tip. *Leaflets* chartaceous, obovate, obovate- or elliptic-oblong, or elliptic, 8.5–13.5(–18) by 3.5–6(–8) cm; apex shortly bluntly acuminate, or acuminate; base obtuse or rounded, often symmetric; on the upper surface puberulous when young, glabrescent, or almost glabrous when old; glaucous and finely, uniformly, appressedly, rather densely when young, puberulous on the lower surface; nerves c. 5 per side; petiolules c. 5 mm, densely brown puberulous when young, glabrescent. *Inflorescences* axillary or terminal, up to 12 cm long, erect, the rachis densely puberulous; bracts small, triangular, c. 1 mm long, puberulous outside, ciliate on the margin; bracteoles almost at the base of the flower, minute, ovate, c. 0.5 mm long;

pedicels very short, 1–2 mm long, articulated at the base, minutely puberulous. *Flowers* minutely, appressedly puberulous outside. *Hypanthium* c. 1 mm long, glabrous inside. *Calyx* lobes ovate or elliptic, 3–5 by 2–2.5 mm, glabrous inside, ciliate on the margin, with 3 obscure, longitudinal veins. *Stamens* (9 or) 10; filaments 3–7(–10) mm; anthers c. 1 mm long. *Pistil* stipitate; stipe free, 0.5–1 mm long, glabrous or hairy at the apical part; ovary 2–3 mm long, (3- or) 4- (or 5-) ovuled; style 6–7 mm, glabrous; stigma obscure. *Pods* not seen.

Distribution — *Malesia*: Malay Peninsula (E and S regions), Borneo (Sarawak).

Habitat & Ecology — In forests, undulating land, a few metres above sea level. Fl. April, May.

26. *Crudia venenosa* de Wit

Crudia venenosa de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 433. — Type: *Maidin SAN (A) 1692* (BO holo; K, L photo), Sabah.

Tree 8 m high. *Stipules* caducous, not seen. *Leaves* 4–6-foliolate, shortly petioled; petiole and rachis 6.5–10 mm long, or longer, not prolonged beyond the upper petiolule. *Leaflets* chartaceous, elliptic, elliptic- or obovate-oblong, 11–18 by 5–6.8 cm, apex abruptly shortly acuminate; base rounded, symmetric; glabrous above, sparsely minutely puberulous below; nerves 5–8 per side; petiolules distinct, c. 7 mm, glabrous. *Inflorescences* axillary or terminal, up to c. 10 cm long, the rachis puberulous, loosely flowered; bracts triangular, 0.5–2.5 mm long, glabrous except ciliate at the margins; bracteoles minute, triangular, c. 1 mm long; pedicels 2–6 mm, articulated at the base, puberulous. *Flowers* green, puberulous outside. *Hypanthium* 1–2 mm long. *Calyx* lobes elliptic or ovate, 3–4 by c. 2 mm. *Stamens* 10, alternately longer and shorter. *Pistil* shortly stipitate; stipe glabrous; ovary c. 2.5 mm long, 3- or 4-ovuled; style glabrous; stigma obscure. *Pods* not seen.

Distribution — *Malesia*: Borneo (Sabah).

Habitat & Ecology — Swampy land, 8 m altitude. Fl. March.

Note — This species is so far known only from the type collection.

27. *Crudia viridiflora* Whitmore

Crudia viridiflora Whitmore, Gard. Bull. Sing. 26 (1973) 285. — Type: *FRI 15949* (KEP holo; K, L), Malay Peninsula.

Tree 21 m high and 29 cm in diam. *Stipules* lanceolate, 1.5–2 mm long, deciduous. *Leaves* 1- (or 2-) foliolate; petiole up to 12 mm, the apical part prolonged laterally at the base of the petiolule into a usually deciduous, short tip, petiolule up to c. 5 mm, both loosely puberulous. *Leaflets* chartaceous or subcoriaceous, oblong- or obovate-elliptic, 15–22 by 6–8 cm; apex rotund, or apiculate; base cuneate, symmetric; almost glabrous except sometimes sparsely puberulous often along the midrib above, loosely, minutely puberulous beneath; nerves c. 9 per side. *Inflorescences* terminal, or sometimes seemingly axillary, solitary or up to 4-fasciculate, 7–12 cm long, erect, puberulous, densely

flowered; bracts ovate, sometimes 3-lobed at the apical part, c. 2 mm long, puberulous outside, persistent; bracteoles at the lower part of the pedicel, very small, triangular, c. 1 mm long; pedicels c. 3 mm, articulated at the base, puberulous. *Flowers* green, sparsely puberulous outside. *Hypanthium* c. 1 mm long, loosely puberulous inside. *Calyx* lobes ovate or obovate, 4–5 by 2.5–3.5 mm, glabrous inside. *Stamens* (8–)10; filaments 5–10 mm, glabrous; anthers c. 1 mm long; connective slightly broader than the anther cells. *Pistil* shortly stipitate; stipe c. 1 mm, free, slightly loosely puberulous; ovary 2–3 mm long, (3- or) 4-ovuled; style 3–5 mm, hairy except glabrous at the apical part; stigma slightly thicker than the style. *Pods* not seen.

Distribution — *Malesia*: Malay Peninsula (Pahang).

Habitat and Ecology — Alluvial valley floor. Fl. Feb.

Note — The species is only known from the type collection. In the original publication the leaves were described as simple ('foliis simplicibus'). However, they are distinctly either unifoliate or bifoliate as examined from the isotype in Leiden.

28. *Crudia wrayi* Prain

Crudia wrayi Prain, J. As. Soc. Beng. 66, ii (1897) 222, 488; Ridley, Fl. Malay Penins. 1 (1922) 646; Whitmore in Tree Fl. Malaya 1 (1972) 252. — Type: Wray 2874 (K holo; L photo), Malay Peninsula. *Crudia havilandii* Prain, J. As. Soc. Beng. 73, ii (1904) 199; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 423. — Lectotype (De Wit 1950): *Haviland 3070* (K holo; L photo); syntype: *Haviland & Hose 3703* (K, L); both Sarawak.

Tree to 35 m high and 60 cm in diameter; buttresses steep to 3.6 m high, 3 m wide, 5.2 cm thick. *Stipules* intrapetiolar, lanceolate, 2–3.5 mm long, deciduous. *Leaves* 3–5 (–7)-foliolate, shortly petioled; petiole and rachis 1.5–4 (–6.5) cm long, loosely puberulous, glabrescent, or glabrous, prolonged beyond the upper petiolule into a usually deciduous, short tip. *Leaflets* chartaceous or subcoriaceous, elliptic, ovate- or obovate-elliptic, (3.5–)5.5–13 by (1.3–)2.5–5 cm, the lower ones usually smaller; apex acuminate or caudate; base obtuse, or cuneate, symmetric; sparsely puberulous or glabrous above, loosely, minutely puberulous beneath; nerves 4–8 per side; petiolules short, 2–5 mm, puberulous, glabrescent, or glabrous. *Inflorescences* axillary or terminal, up to c. 9 (–20) cm long, erect, the rachis puberulous, moderately loosely flowered; bracts deltoid or 3-lobed, up to 4 mm long, sparsely puberulous outside, caducous; bracteoles at about halfway (or lower half of) the pedicel, minute, triangular, c. 0.6 mm long; pedicels 3–4 mm, articulated at the base, sparsely puberulous. *Flowers* whitish, sparsely puberulous outside. *Hypanthium* c. 0.6 mm long, glabrous inside. *Calyx* lobes unequal, broadly elliptic, elliptic, or oblong, 3.5–4 by 2.5–3 mm, glabrous inside. *Stamens* (8–)10; filaments up to c. 11 mm, glabrous; anthers c. 1 mm long. *Pistil* shortly stipitate; stipe c. 1.5 mm long, free, glabrous; ovary c. 3.5 mm long, 2 (–4)-ovuled; style c. 8 mm, glabrous; stigma obscure, slightly thicker than the style. *Pods* ovate-oblong or broadly elliptic, 5–8 by 3.5–4.5 cm, with a very short beak, brownish hairy, 1 (or more-)seeded. *Seeds* broadly obovate, c. 3.5 by 2.5 cm.

Distribution — *Malesia*: Malay Peninsula (Kedah, Perak, Johore), Borneo (Sarawak, Kalimantan).

Habitat & Ecology — In primary lowland Dipterocarp forest, riverbanks and swampy places, once recorded at base of limestone at Bau (near Kuching), up to c. 90 m altitude. Fl. Sept., Oct., Dec.; fr. Jan., March, Sept.

Note — Trees of this species have been numbered as no. 45 and no. 236 respectively in the Arboretum, Semengoh Forest Reserve, near Kuching, Sarawak. Good flowering specimens (e.g. *S 11019*, L) were collected from the numbered trees, collections with ripe fruits are still needed.

DOUBTFUL TAXA

Crudia curtisii Prain var. *wallichii* Prain, J. As. Soc. Beng. 66, ii (1897) 221, 487; Ridley, Fl. Malay Penins. 1 (1922) 645. — Syntypes: *Wallich Cat. no. 5983 & 8089* (K), Penang I.

Leaflets papery, 7–9, uniformly densely softly velvety beneath, leaflets acute not cuspidate or caudate at apex.

Distribution — *Malesia*: Malay Peninsula (Penang I.).

Note — Prain (l.c.: 487) described the characters of his variety as copied above, and also recorded its vernacular name as ‘Kumpas ruman’. Ridley (l.c.) already clearly stated that the “var. *wallichii* Prain is based on specimens collected by *Wallich 5983* and *8089*. They are leaf-specimens only, very hairy and quite indeterminable.”

Crudia orientalis Hassk., Cat. Hort. Bot. Bogor. (1844) 288 (‘*Crudya*’); Miq., Fl. Ind. Bat. 1, 1 (1855) 80 (‘*Crudya*’); de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1950) 433. — Type unknown (vernacular name: Aroj kitjienteh, Java).

Shrub. *Leaves* 7-jugate; rachises and branchlets rusty-tomentose. *Leaflets* with acute apex, rotundate at the base, and rusty ciliate margin. *Pod* thick, brown tomentose, 2-seeded.

Distribution — Uncertain. ?Java.

Note — The authentic material of this species has not been located. De Wit (l.c.) has already expressed that it “is not at all certain that this is a species of *Crudia*.”

CYNOMETRA

(Ding Hou)

Cynometra L., Sp. Pl. (1753) 382; Gen. Pl., ed. 5 (1754) 179; Meeuwen, Blumea 18 (1970) 12; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 77; Cowan & Polhill in Polhill & Raven, Adv. Leg. Syst. 1 (1981) 124; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 22. — Lectotype species (Britton & Wilson 1926): *Cynometra cauliflora* L.

Trees or *shrubs*. *Buds* small, with numerous brown scales in two ranks. New leaves developing in bright pink tassels. *Stipules* caducous immediately after unfolding of the bud, leaving hardly any scar. *Leaves* simply pinnate, 1–3(–6)-jugate, rarely unifoliate or seemingly simple. *Leaflets* opposite, asymmetric, entire and mostly glabrous; petio-

lules usually very short. *Inflorescences* axillary, paniculate, racemose, or spike-like, solitary, sometimes 2 per axil, rarely cauliflorous and fasciculate, mostly spherical in outline, sometimes elongated, sessile, densely flowered; bracts scale-like, mostly persistent, appressed-hairy, often glabrescent; bracteoles caducous. *Flowers* bisexual. *Hypanthium* usually shortly campanulate, circumscissile under the ripe fruit and then falling off, sometimes obscure or absent. *Sepals* 4 (or 5), imbricate, reflexed at anthesis. *Petals* 5 (or 4), narrow, free, glabrous. *Disk* absent. *Stamens* (8–)10(–15); filaments free, rarely united at the base, usually glabrous; anthers medi-dorsifix, lengthwise dehiscent, introrse, usually sagittate below and apiculate at the apex. *Ovary* usually stipitate and pubescent, 1–4-ovuled (1-, rarely 2-ovuled in Indo-Malesian species). *Fruits* usually thickened, indehiscent, often flattened especially when young, smooth or rugose, sometimes warty, 1(–4)-seeded. *Seeds* exalbuminous.

Distribution — About 70 species, pantropical, in the western Pacific found eastwards as far as Micronesia, the Solomons and Fiji; 14 species (13 indigenous and 1 cultivated) occurring in *Malesia*.

Habitat — In forests, sometimes growing on banks of rivers or streams, or found in coastal areas, from lowland up to 1300 m altitude.

Uses — The timber of *Cynometra* species is not or moderately durable and, consequently, only suitable for interior construction, unless treated with preservative. Several species are treated in Soerianegara et al. in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 1512–155..

Notes — 1. This presentation of the genus *Cynometra* is mainly based on the revisions by Knaap-van Meeuwen (1970) and Verdcourt (1979) as cited above.

2. For delimitation of *Cynometra* and *Maniltoa*, see the note to the latter genus.

KEY TO THE SPECIES

- 1a. Leaves unifoliolate or seemingly simple **13. *C. simplicifolia***
- b. Leaves 1–3(–6)-jugate 2
- 2a. Leaves 4–6-jugate 3
- b. Leaves 1–3-jugate 4
- 3a. Leaflets extremely unequal, the lower pair elliptic or ovate, very small, 0.5–1.6 cm long, acute at the apex, the upper pair lanceolate, 7.5–16 cm long, acuminate at the apex. Rachis of inflorescence absent. Stamens 12, all fertile **7. *C. katikii***
- b. Leaflets not as above, ovate-oblong to oblong, 1.8–2 cm long, very deeply emarginate at the apex. Rachis of inflorescence 2.5–4.5 mm. Stamens 10, one sterile **3. *C. copelandii***
- 4a. Inflorescences 4 or 5, borne on hard knots on the trunk. Leaves 1-jugate. Fruits fleshy, 2.7–3 by 1.8–2 by 1 cm, rugose. Known only in cultivation **2. *C. cauliflora***
- b. Inflorescences usually solitary, axillary 5

- 5a. Petiole 2 mm. Leaflets small, (1.8–)3.5–4.5 by (0.7–)1.1–1.4 cm; apex acuminate, emarginate and mucronate at the tip **9. *C. minutiflora***
- b. Petiole usually more than 4 mm, up to 15 mm. Leaflets usually much larger ... 6
- 6a. Leaflets obtuse or rounded at the apex 7
- b. Leaflets acuminate at the apex 9
- 7a. Leaves 2-jugate, petiole 6–15 mm. Leaflet pairs of unequal size, the upper one 11–20 by 4–8 cm, the lower one 4–8.5 by 1.8–5 cm **5. *C. inaequifolia***
- b. Leaves 1- or 2-jugate, petiole 2–4 mm. Leaflets about the same size 8
- 8a. Rachis of inflorescence 3–4 mm. Bracts minute, c. 1 mm long. Petals small, 2 mm long. Anthers more or less apiculate. Fruits deeply rugose **6. *C. iripa***
- b. Rachis of inflorescence 5–6 mm. Bracts larger, c. 3 mm long. Petals 4.5 mm long. Anthers not apiculate. Fruits unknown **14. *C. warburgii***
- 9a. Rachis of inflorescence or infructescence very short, less than 4 mm long 10
- b. Rachis of inflorescence or infructescence longer, 10–45 mm long 11
- 10a. Leaflets 14–25 by 4.7 cm, tip of acumen pointed, not emarginate **1. *C. brachymischa***
- b. Leaflets smaller, 4–7 by 1–3 cm, tip of acumen emarginate **11. *C. novoguineensis***
- 11a. Fruits deeply rugose. Rachis of inflorescence 13–25 mm; pedicels 7–15 mm ... **12. *C. ramiflora***
- b. Fruits smooth or rough, not rugose 12
- 12a. Fruits asymmetrical, convex on outer side, straight on inner side, rough. Rachis of infructescence 4.5 cm long **4. *C. elmeri***
- b. Fruits ± symmetrical, smooth. Rachis of inflorescence 0.5–3 cm long 13
- 13a. Pedicels of flowers 18–26 mm. Petals 7 mm long **10. *C. mirabilis***
- b. Pedicels of flowers 4–8 mm. Petals smaller, 2–4 mm long **8. *C. malaccensis***

1. *Cynometra brachymischa* Harms

Cynometra brachymischa Harms, Bot. Jahrb. 55 (1917) 46; Meeuwen, Blumea 18 (1970) 31; Verde., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 79. — Type: *Schlechter* 19772 (B, destroyed), Papua New Guinea.

Tree or *shrub* with slender glabrous branchlets. *Leaves* 1-jugate, petiole 4–6 mm. *Leaflets* inequilateral, obliquely lanceolate to oblong-lanceolate, 14–25 by 4–7 cm, glabrous, acuminate at the apex, obliquely obtuse at the base, the midrib nearest the upper margin. *Inflorescences* very short, racemose, sessile, few- to many-flowered; bracts broad, obtuse, scarious, striate; pedicels very short. *Hypanthium* hairy. *Sepals* 5–6 mm long, hairy. *Petals* lanceolate, unguiculate, acute, membranous, not exserted. *Stamens* 10. *Ovary* small, sessile, hirsute; style elongate, filiform, puberulous at the base; stigma minute. *Fruit* not seen.

Distribution — *Malesia*: Papua New Guinea (Morobe Prov.).

Habitat & Ecology — Mountain forest, 1300 m altitude. Fl. June.

Note — According to Verdcourt (l.c.) this "is an upland species the fruits of which are unknown but presumably like those of *C. ramiflora*."



Fig. 28. *Cynometra cauliflora* L. Basal part of tree bearing both flowers and fruits. Photograph of a water-colour drawn by A. Bernecker. Original plate in Leiden; photograph B. Kieft, $\times 0.4$.

2. *Cynometra cauliflora* L.

Cynometra cauliflora L., Sp. Pl. (1753) 382; Koord. & Valetton, Bijdr. Booms. Java I (1894) 271; Meeuwen, Blumea 18 (1970) 20; Whitmore in Tree Fl. Malaya I (1972) 254; Kosterm., Reinwardtia 10 (1982) 68; K. & S.S. Larsen in Fl. Thailand 4 (1984) 46; H. Keng, Conc. Fl. Sing. (1990) 34. — Type: *Cynomorium* Rumph., Herb. Amb. 1 (1741) t. 62.

Cynometra cauliflora L. α *subsessilis* et β *elongatis* Hassk., Flora, Beibl. (1842) 95; Pl. Jav. Rar. (1848) 413. — Type: *Herb. Reinwardt s.n.* (L holo, sh. 908.114-1892 and -1893, respectively).

Cynometra acutiflora Vidal, Rev. Pl. Vasc. Filip. (1886) 118. — Type: *Vidal 1278* (not seen), Luzon.

Tree 3–15 m tall. *Leaves* 1-jugate. *Leaflets* ovate, ovate-oblong to ovate-lanceolate, 5.5–16.5 by 1.6–5.6 cm; apex obtuse, emarginate, or slightly acuminate; nerves 7–10 (–14) pairs; petiole 2–8 mm, glabrous, sometimes pubescent; petiolules very short, sometimes pubescent. *Inflorescences* cauliflorous: 4 or 5 small racemes fascicled on hard knots on the trunk; rachis 0.5–3 cm long, glabrous; bracts 1–10 mm long, ciliate; bracteoles 1.5 mm long, inserted 1.25–2 mm above the base of pedicels; pedicels 3–6.5 mm, laxly pubescent or glabrous. *Hypanthium* 1–2 mm. *Sepals* 2–4 mm long. *Petals* 3–4 mm long. *Stamens* (8–)10, varying in one plant; filaments rarely with 1 or 2 hairs. *Ovary* rather densely hairy, with long and short hairs; stipe 0.75 mm; style 5–6 mm, hairy up to halfway. *Fruits* fleshy, rather kidney-shaped, rugose, 2.7–3 by 1.8–2 by 1 cm, glabrescent. — **Fig. 28.**

Distribution — Only known in cultivated state, possibly a cultigen derived from eastern *Malesia*, not common; introduced and cultivated in various places in *Malesia* for its edible fruits. It is now also cultivated in India. See Burkill, Diet. Econ. Prod. Malay Penins. (1935) 730.

Habitat — Cultivated in places at low altitude and also in gardens.

Uses — Fruits can be eaten raw, but are better stewed with sugar. They are also used as seasoned additions to food or pickled.

3. *Cynometra copelandii* (Elmer) Elmer

Cynometra copelandii (Elmer) Elmer, Leafl. Philipp. Bot. 8 (1915) 2734; Meeuwen, Blumea 23 (1970) 17. — *Gleditschia copelandii* Elmer, Leafl. Philipp. Bot. 2 (1910) 695. — Type: *Elmer 12234* (PNH holo, destroyed; BO, L), Sibuyan Is.

Tree 15 m. *Leaves* 4–6-jugate; leaflets sessile, ovate-oblong to oblong, 1.8–2 by 0.5–0.8 cm, with a few hairs on the midrib on both surfaces, glabrescent; apex very deeply emarginate; midrib 1.5–3 mm from the upper margin; nerves 6–9 pairs, barely visible; margin thickened; petiole c. 3 mm, rachis 3–3.5 cm, both densely, patently hairy. Rachis of *inflorescences* 2.5–4.5 mm, hairy; bracts up to 9 mm long, hairy, glabrescent; bracteoles 1.5–3.5 mm long, inserted slightly above the base of pedicel; pedicels up to 7 mm, patently densely hairy. *Hypanthium* minute. *Sepals* up to 4 mm long, with a few hairs on the outside. *Petals* 4.5 mm long. *Stamens* 10, and with a sterile one. *Ovary* laxly long-hairy; stipe 0.5 mm long; style up to 4 mm, hairy in the lower half. *Fruit* not seen.

Distribution — *Malesia*: Philippines (Sibuyan Is.), only known from the type.

Habitat — In forests at c. 250 m altitude.



Fig. 29. *Cynometra elmeri* Merr. Flowering branch. Sanggau, W Kalimantan. Photograph A. Elsener, 8 June 1941.

4. *Cynometra elmeri* Merr.

Cynometra elmeri Merr., Pl. Elmer. Born. (1929) 98; Meeuwen, Blumea 18 (1970) 29, f. 3; Meijer, Field Guide Trees W Mal. (1974) 181, f. 42; Cockb., Trees Sabah 1 (1976) 162, f. 34. — Type: Elmer 21386 (erron. as '21368'), Sabah.

Cynometra inaequifolia auct. non A. Gray: Ridley, Kew Bull. (1938) 279.

Tree 10–25 m tall. *Leaves* 1-jugate, petiole 4–8 mm. *Leaflets* ovate-oblong or oblong, more or less falcate, 3.5–15 by 1.3–4 cm; apex acuminate, tip blunt and emarginate; nerves 5–7 pairs. *Flowers* not seen. *Rachis of infructescence* 4.5 cm. *Fruit* with a stalk c. 10 mm, pendulous, flat, 4–6 by 2.5–3.5 by 0.7 cm, inner suture more or less straight, outer suture widely curved, with a small beak on the inner suture side of the apex, surface rough. — **Fig. 29.**

Distribution — *Malesia*: Borneo (Sabah), Philippines (Luzon: Rizal Prov.).

Habitat — Forest back mangrove and swamps, 50–300 m altitude.

5. *Cynometra inaequifolia* A. Gray

Cynometra inaequifolia A. Gray in Wilkes, U.S. Expl. Exped., Phan. 1 (1854) 473; Merr., Philipp. J. Sc., Bot. 5 (1910) 36; Meeuwen, Blumea 18 (1970) 26, f. 1a. — Type: Wilkes, US Expl. Exped., Luzon, Los Baños (not located in GH and US); paratype: *Cuming* 1297 (BM, K).

Tree up to 20 m tall. *Leaves* 2-jugate, petiole 6–15 mm, rachis 2.5–5.5 cm. *Leaflets* coriaceous, ovate or elliptic, ovate-oblong or oblong, (4–)11–20 by (1.8–)4–8 cm, glabrous; apex obtuse, tip sometimes emarginate; nerves (6–)9 or 10 pairs. Rachis of *inflorescence* 10–12 mm long, densely pubescent; bracts 4–5 mm long, very densely hairy; bracteoles 1.5–2 mm long, inserted at 0.2–0.75 mm on the pedicel; pedicels 10–17 mm, pubescent. *Hypanthium* c. 1–1.5 mm deep. *Sepals* 4 mm long, laxly pubescent. *Petals* 4 mm long. *Stamens* 6–7 mm; anthers 0.8 mm long. *Ovary* densely pubescent and with scattered hairs; stipe 1.5 mm; style 4 mm, with a few hairs. *Fruits* 4–4.5 by 2–2.5 by 0.7 cm, surface rough, but not rugose.

Distribution — *Malesia*: Philippines (Luzon, Panay, Negros).

Habitat — Forests at low and medium altitudes.

6. *Cynometra iripa* Kostel.

Cynometra iripa Kostel., Allg. Med. Pharm. Fl. 4 (1835) 1341; Meeuwen, Blumea 18 (1970) 21, f. 1d; Whitmore in Tree Fl. Malaya 1 (1972) 254; Kosterm., Reinwardtia 10 (1982) 66; Rudd in Fl. Ceylon 7 (1991) 91. — Type: *Iripa* Rheede, Hort. Malab. 4 (1673) t. 31.

Cynometra ramiflora var. β Wight & Arn., Prod. Fl. Ind. Orient. (1834) 293. — *Cynometra ramiflora* var. *mimosoides* Baker in Hook. f., Fl. Brit. India 2 (1878) 267; Ridley, Fl. Malay Penins. 1 (1922) 635. — *Cynometra bijuga* var. *mimosoides* Merr., Philipp. J. Sc., Bot. 5 (1910) 36. — Lectotype (Knaap-van Meeuwen 1970): Wallich Cat. no. 5817A (K holo; BO, G).

Shrub or *tree* 3–8 m tall. *Leaves* 1- or 2-jugate. *Leaflets* ovate, elliptic, ovate-oblong or oblong, 1.5–9 by 0.9–2.1 cm; apex rounded, always emarginate, sometimes mucronate; nerves 5–7 pairs; petiole 4 mm, rachis 13 mm, petiolules c. 1 mm, all shortly hairy. Rachis of *inflorescence* 3–4 mm, densely pubescent; bracts minute, 1 mm long, hairy, glabrescent; bracteoles 2 mm long, inserted at 0.25–2 mm above the base of the pedicel; pedicels 4–6 mm, patently shortly hairy. *Hypanthium* 0.8–1 mm deep. *Sepals* 2.5–3.5 mm long, rather long-hairy. *Petals* very narrow, 2 by 0.3 mm. *Stamens* 3–5 mm; anthers more or less apiculate. *Ovary* densely, patently long-hairy, inside hairy; stipe 1 mm; style 3–3.5 mm, glabrous. *Fruits* ellipsoid, c. 6 by 2 cm, deeply rugose, shortly patent-hairy, the distal part beak-like and pointing obliquely.

Distribution — Sri Lanka, India, Burma, Thailand (Peninsular), through *Malesia*, to Micronesia, Marianas (Guam) and Australia (N Queensland); in *Malesia*: Malay Peninsula (Kedah, Setul, Kuala Lumpur, Malacca), Java, Philippines (Panay, Tablas, Mindanao).

Habitat — Mangrove swamps, littoral scrub, on or near the beach, but also found in the hills up to 500 m altitude.

7. *Cynometra katikii* Verdc.

Cynometra katikii Verdc., Kew Bull. 32 (1977) 235, f. 2; Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 80, f. 18. — Type: *Katik NGF 46670* (LAE holo; K, L), Papua New Guinea.

Tree 7.5–18 m tall and 30 cm in diam. *Leaves* (2?)4-jugate, petiole c. 1 cm. *Leaflets* extremely unequal, the lower pair very small (bract-like at the base of an inflorescence), elliptic, 0.5–1.6 by 0.3–0.8 cm, acute at the apex, rounded at the base, the upper pair lanceolate, 7.5–16 by 1.2–2.7 cm, acuminate at the apex, cuneate to rounded at the base, both glabrous above, rusty hairy beneath; petiolules very short, c. 1.5 mm. *Inflorescences* axillary, sessile, fasciculate, 1–1.5 cm long; bracts ovate, 3 mm long, densely striate; bracteoles boat-shaped, 2.8 mm long, puberulous; pedicels 3 mm. *Hypanthium* absent. *Flowers* white. *Sepals* oblong, 3.5 by 1.5 mm. *Petals* linear, 2.5 by 0.1 mm. *Stamens* 12; filaments 5 mm, united at the basal 0.5 mm. *Ovary* shortly stipitate, 2 mm long, densely hairy. *Fruits* peach-shaped, 6 cm long, 4.3 cm wide and thick, hard and brown, longitudinally grooved at the side, rugose and obscurely scaly. *Seeds* kidney-shaped, 3.5 by 2.7 by 2.4 cm, rugose.

Distribution — *Malesia*: Papua New Guinea (East Sepik & Madang Provinces).

Habitat — In rain forest, at about 50 m altitude.

8. *Cynometra malaccensis* Meeuwen

Cynometra malaccensis Meeuwen, Blumea 18 (1970) 18, f. 2; Whitmore in Tree Fl. Malaya 1 (1972) 254, f. 1, 5; K. & S.S. Larsen in Fl. Thailand 4 (1984) 45. — Type: *Kochunmen CF 94633* (L holo; KEP), Malay Peninsula.

Cynometra inaequifolia auct. non A. Gray: Baker in Hook. f., Fl. Brit. India 2 (1878) 267; Prain, J. As. Soc. Beng. 66, ii (1897) 199 ('*inaequalifolia*'); Ridley, Fl. Malay Penins. 1 (1922) 635; Corner, Wayside Trees (1940) 392, f. 127.

Tree, 20–40 m. *Leaves* 2- or 3-jugate. *Leaflets* ovate-oblong to oblong, 4–11 by 1.8–3.5 cm; shortly acuminate, slightly emarginate at the tip; midrib 6–15 mm from the upper margin; nerves 5–7 pairs; petiole 3–8 mm, rachis 5–6 cm, puberulous. Rachis of *inflorescence* 2–3 cm, puberulous; bracts 2–9 mm long, tomentose, sometimes glabrescent; bracteoles 3–4 mm long, inserted at the base of pedicel; pedicels 4–8 mm, strigose to tomentose, sometimes laxly hairy. *Hypanthium* 1.25–2 mm deep. *Sepals* 3–4 mm long. *Petals* 2–4 mm long. *Stamens* 3–6 mm. *Ovary* sericeous, woolly or villous; stipe 0.8–1.5 mm; style 0.5–3 mm. *Fruits* broadly obovoid, ellipsoid, slightly reniform, or suborbicular, brown scurfy, 4–5.25 by 3.75–4.5 cm, quite flat when young (0.4–0.5 cm thick), somewhat thickened towards the margin.

Distribution — India, Thailand (Peninsular); in *Malesia*: Malay Peninsula.

Habitat — Common in the lowlands and hills to 600 m; sometimes locally abundant (e.g. Genting Sempah); in suitable sites up to c. 900 m altitude (e.g. Kedah).

9. *Cynometra minutiflora* F. Muell.

Cynometra minutiflora F. Muell., Austral. J. Pharm. 1 (1986) 123; Meeuwen, Blumea 18 (1970) 27; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 80. — Type: *Chalmers s.n.* (MEL holo), SE New Guinea.

Tree or shrub 3–5 m tall. *Leaves* 2-jugate; petiole 2 mm, rachis 12 mm, both shortly patent-hairy. *Leaflets* ovate-oblong or oblong, (1.8–)3.5–4.5 by (0.7–)1.1–1.9 cm, apex acuminate, the acumen acute or spatulate, emarginate and mucronate at the tip; nerves 5 or 7 pairs. Rachis of *inflorescence* very short, 2–3 mm long; bracts minute, almost ovate, glabrous; bracteoles unknown, but their scars visible just above the base of the pedicels; pedicels 2 mm, shortly pubescent. *Hypanthium* minute. *Sepals* 2 by 1.5 mm, slightly hairy. *Petals* unknown. *Stamens* 10, 2–4 mm; anthers 0.5 mm. *Ovary* very shortly stipitate, more or less glabrous; style 2 mm, glabrous. *Fruits* 0.8–2.4 by 0.7–1.6 cm, rough and rugose.

Distribution — *Malesia*: New Guinea (Irian Jaya: Mt Genofa; Papua New Guinea: Central Prov.).

Habitat — Forests, 300–900 m altitude.

10. *Cynometra mirabilis* Meeuwen

Cynometra mirabilis Meeuwen, Blumea 18 (1970) 25, f. 1b. — Type: *Miranda* FB 20528 (L holo; BO, UC, US), Philippines.

Glabrous *tree* 10–20 m tall. *Leaves* 1- or 2-jugate, upper and lower pair of leaflets usually similar in size. *Leaflets* (ob)ovate-oblong to elliptic or oblong, 6.5–12.5 by 3–5 cm, apex acuminate, sometimes slightly emarginate; midrib 10–18 mm from the upper margin; nerves 6 or 7 pairs; petiole 5–10 mm, rachis (if leaves 2-jugate) 4.5–7 cm. Rachis of *inflorescence* 0.6–1 cm long, glabrous or with a few hairs; bracts 1–11 mm, glabrescent; bracteoles small, narrow, 1–4 mm, usually both at base of pedicel, sometimes one halfway; pedicels 18–26 mm, glabrescent. *Hypanthium* 1–1.5 mm deep. *Sepals* 5–6 mm long, glabrous. *Petals* 7 mm long. *Stamens* occasionally with a few hairs. *Ovary* woolly hairy or only with a few hairs outside, inside wall lined with curly appressed hairs; stipe c. 1 mm; style c. 5.5 mm, glabrous or hairy except near the tip. *Fruits* (immature) obovoid, 3 by 1.7 by 0.2 cm, smooth.

Distribution — *Malesia*: Borneo (Sabah), Philippines (Mindanao, Sulu Is.).

Habitat & Ecology — Often found in inland forest, also occurring near the seashore or along rivers, up to 150(–600) m altitude. Fl. May, Aug. Oct.; fr. April.

11. *Cynometra novoguineensis* Merr. & L.M. Perry

Cynometra novoguineensis Merr. & L.M. Perry, J. Arnold Arbor. 23 (1942) 397; Meeuwen, Blumea 18 (1970) 28; Verdc., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 82. — Type: *bb* 25712 (A holo; BO, L), New Guinea.

Tree to 19 m tall. *Leaves* 1-jugate. *Leaflets* obliquely ovate-oblong, oblong, sometimes lanceolate, more or less falcate, 4–7 by 1–3 cm, glabrous, very inconspicuously veined; apex acuminate, tip emarginate; base obliquely cuneate; petiole 4–6 mm. *Inflorescences* very short, rachis less than 4 mm long, few-flowered; bracts c. 1 mm long, obtuse, striate; pedicels 4–5 mm, glabrous. *Hypanthium* minute. *Sepals* oblong-lanceolate, 2 mm long. *Petals* 1 mm long. *Stamens* 10, c. 2 mm. *Ovary* very shortly stipitate, glabrous or laxly hairy at the apex; style c. 2 mm, curved, glabrous. *Pod* not seen.

Distribution — *Malesia*: New Guinea (Irian Jaya: Jayapura).

Habitat — Swampy area at 50 m altitude.

Note — Only known from the type and one additional sterile collection.

12. *Cynometra ramiflora* L.

Cynometra ramiflora L., Sp. Pl. (1753) 382, excl. syn. *Iripa* Rheede; Merr., Interpr. Rumph. (1917) 254; Meeuwen, Blumea 18 (1970) 23, f. 1c; Whitmore in Tree Fl. Malaya 1 (1972) 254, f. 5, p.p.; Keng, Gard. Bull. Sing. 27 (1974) 258; Cockb., Trees Sabah 1 (1976) 162, f. 34, p.p.; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 82; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 118, pl. 20/3–5; in Fl. Thailand 4 (1984) 48, f. 10/3–5; H. Keng, Conc. Fl. Sing. (1990) 34. — Type: *Cynomorium sylvestre* Rumph., Herb. Amb. 1 (1741) t. 63.

Cynometra polyandra auct. non Roxb.: Miq., Anal. Bot. Ind. 1 (1850) 11.

Cynometra bijuga Span. ex Miq., Fl. Ind. Bat. 1, 1 (1855) 78. — *Cynometra ramiflora* subsp. *bijuga* Prain, J. As. Soc. Beng. 66, ii (1897) 198, 478, p.p.; Backer & Bakh. f., Fl. Java 1 (1964) 526. — Type: Unpublished drawing no. 6 of Spanoghe (L).

Cynometra schumanniana Harms, Notizbl. Berl.-Dahl. 3 (1902) 186; in K. Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzgeb. Südsee (1905) 274. — Type: *Hollrung* 736 (B holo, destroyed; iso BO, L), Papua New Guinea.

Cynometra whitfordii Elmer, Leaf. Philipp. Bot. 8 (1915) 2734. — Type: *Elmer* 13465 (PNH holo, destroyed; iso K, L), Mindanao.

a. var. *ramiflora*

Tree 4–26 m tall. *Leaves* 1- and/or 2-jugate, rarely 2-jugate only. *Leaflets* ovate, ovate-oblong, oblong, elliptic, lanceolate, rarely orbicular, (1.2–)4.5–6.5(–20) by (0.5–)2.5–3.5(–7) cm; apex acute or acuminate; nerves (4–)8–16 pairs; petiole 3–15 mm, rachis 15–40 mm, both sometimes patent-hairy, glabrescent, or glabrous; petioles indistinct. Rachis of *inflorescence* 1.3–2.5 cm, usually glabrescent, sometimes glabrous; bracteoles 3–4 mm long, inserted at or near the base of the pedicel; pedicels 7–15 mm, densely patent-hairy or pubescent, sometimes glabrescent or glabrous. *Hypanthium* 1–1.25 mm deep. *Sepals* 4–6 mm long, usually with a few hairs near the tip, sometimes hairy all over, sometimes glabrous. *Petals* 5–8 mm long, lanceolate, sometimes with a small mucro. *Stamens* 10 (once found 11, 13, and 15, respectively). *Ovary* densely, often curly hairy, 1- (or 2-)ovuled; stipe 1 mm; style 4–5.5 mm, with a few hairs up to halfway. *Fruits* broad-ovoid or -ellipsoid, the tip pointing up, thick-woody, deeply rugose, shortly brown, scurfy, 2.2–5 by 1.3–4 cm.

Distribution — From India throughout SE Asia and *Malesia* to the Pacific, not in Sri Lanka and Australia.

Habitat — In the back-mangrove forest; also occurring inland up to 400 m altitude.

Uses — The dark brown timber is heavy and hard but not very durable. It is only available in small quantity and is used in construction.

b. var. *bifoliolata* (Merr.) Meeuwen

Cynometra ramiflora L. var. *bifoliolata* (Merr.) Meeuwen, Blumea 18 (1970) 25. — *Cynometra bifoliolata* Merr., Philipp. J. Sc., Bot. 12 (1917) 272. — Type: *Barros* FB 24211 (PNH holo, destroyed; K, US), Luzon.

Petiolules distinct, 5–8 mm.

Distribution — *Malesia*: Philippines (Luzon, Mindanao).

Habitat — On riverbanks, at low altitude.

13. *Cynometra simplicifolia* Harms

Cynometra simplicifolia Harms, Notizbl. Berl.-Dahl. 3 (1902) 186; Meeuwen, Blumea 18 (1970) 16. — Type: *Cuming 1134* (iso BM, K, L), Luzon.

Cynometra luzoniensis Merr., Philipp. J. Sc., Bot. 4 (1909) 266. — Type: *Merrill 2128* (iso US), Luzon.

Cynometra simplicifolia var. *oblongata* Merr., Philipp. J. Sc., Bot. 5 (1910) 37. — Lectotype (Knaap-van Meeuwen 1970): *Ahern's Coll. FB 2978* (iso K, NY, US), Luzon.

Small *tree* 4–6 m tall. *Leaves* unifoliolate, symmetric, narrowly triangular, or nearly broadly ovate, ovate-oblong or lanceolate, 2.5–16 by 1–6 cm; apex shortly acuminate, acuminate or cuspidate; base rounded or auriculate; nerves 5–7 pairs; petiole 1–8 mm, shortly patent-hairy, glabrescent. *Rachis* of *inflorescence* 6–7 mm long, hairy, glabrescent; bracts 2.5 by 2.5–3(–4) mm, ciliate, hairy; bracteoles 2 mm long, inserted at the base of the pedicel or slightly above it; pedicels 5–10 mm, patently sometimes laxly hairy, glabrescent. *Hypanthium* minute. *Sepals* 2 mm long, with a few hairs. *Petals* 2.5 mm long. *Stamens* 10 (or 11). *Ovary* densely hairy, glabrescent; style 3 mm. *Fruits* subsessile, orbicular or kidney-shaped, 4.5 by 3.5 cm.

Distribution — *Malesia*: Philippines (Luzon, Mindoro, Mindanao, Basilan).

Habitat — In thickets and open dry forests on slope of mountains, at low and medium altitudes up to 1300 m.

14. *Cynometra warburgii* Harms

Cynometra warburgii Harms, Notizbl. Berl.-Dahl. 3 (1902) 187; Merr., Philipp. J. Sc., Bot. 5 (1910) 37; Enum. Philipp. Flow. Pl. 2 (1923) 255; Meeuwen, Blumea 18 (1970) 28. — Lectotype (Knaap-van Meeuwen 1970): *Warburg 12427*; syntype: *Warburg 12086* (both holo in B, destroyed), both from Luzon.

Tree 10 m tall. *Leaves* 1-jugate. *Leaflets* ovate-oblong, oblong, or lanceolate, 3.2–6.5 by 0.8–2.7 cm, glabrous; apex obtuse (tip not emarginate); nerves 7 pairs; petiole 2–4 mm. *Inflorescences* short, the rachis 5–6 mm long; bracts 3 by 2 mm, glabrous on the back, ciliate on the margin; bracteoles caducous, their scars visible on the pedicel just above its base; pedicels 3–4 mm, glabrous. *Hypanthium* minute. *Sepals* 3.5 mm long. *Petals* 4.5 mm long. *Stamens* 5–6 mm long; anthers not apiculate. *Ovary* glabrous, obliquely inserted in the receptacle; stipe 0.8 mm; style 3.5 mm. *Fruit* not seen.

Distribution — *Malesia*: Philippines (Luzon).

Habitat — In forests, chiefly near streams at low and medium altitudes.

INCOMPLETELY KNOWN TAXA

In many herbaria there are sterile or incomplete Malesian specimens of *Cynometra*, mostly from New Guinea. They are very difficult to name and some of them may re-

present undescribed taxa. Verdcourt (Manual New Guinea Leg. 1979: 83–87) has recorded several undescribed taxa of this genus from New Guinea, under the species **a** to **g**, citing the specimens examined and hoping that fertile or complete collections will be available in the near future.

DIALIUM

(J. P. Rojo)

Dialium L., Mant. 1 (1767) 3; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101; Rojo, Unpubl. Thesis Oxford (1982) 156–248. — Type species: *Dialium indum* L.
Dansera Steenis, Bull. Bot. Gard. Buitenzorg III, 17 (1948) 413. — *Dialium* subg. *Dansera* (Steenis) Steyaert, Reinwardtia 2 (1953) 355. — Type species: *Dansera procera* Steenis [= *Dialium procerum* (Steenis) Steyaert].

Trees, occasionally shrubby. *Stipules* small, very early caducous. *Leaves* unifoliate or imparipinnate, petiole and rachis without conspicuous glands. *Leaflets* generally alternate, margin entire. *Inflorescences* paniculate, terminal or axillary, often in fascicles; bracts not observed, bracteoles very early caducous. *Flowers* bisexual, zygomorphic. *Hypanthium* concave or narrow. *Disc* absent in Malesian species. *Sepals* 5 or 3. *Petals* usually none, sometimes (not in Malesia) 1, 3, or 5. *Stamens* 2 or 6 (in Malesia); anthers basifixed, longitudinally dehiscent. *Ovary* sessile or shortly stipitate; style \pm as long as the ovary; stigma small, punctiform to slightly swollen; ovules (1 or) 2. *Pods* indehiscent; exocarp usually brittle, sometimes firm; mesocarp pulpy. *Seeds* 1 (or) 2, usually reniform, albuminous; testa smooth.

Distribution — Pantropical genus of 27 species, not in Australia and the Pacific Islands. In *Malesia* absent from the islands East of Borneo and Java.

Habitat — In primary and old secondary forests, at low and medium altitudes, in Malesia up to 1150 m.

Taxonomy — The genus is divided into three subgenera, of which one, subgenus *Arouna*, is not represented in the Malesian area.

Uses — The heartwood gives a good general-purpose timber, known as *keranji*. See Rojo & Alonzo in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 161–166.

Fruits (at least those of *Dialium indum* and *D. platysepalum*) are edible, but of slight importance. See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 798–800; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 737–739; Verheij & Coronel, Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 375 (list only).

KEY TO THE SPECIES

- 1a. Sepals 5. Stamens 2, rarely 3 (Subg. *Dialium*) 2
- b. Sepals 3. Stamens 6 (Subg. *Dansera*) 4
- 2a. Ovary inserted on flattish, patent-hairy receptacle **1. D. hydnocarpoides**
- b. Ovary inserted on narrow or concave receptacle 3

- 3a. Receptacle concave. Anthers v-channeled on abaxial side, filaments flattish **3. *D. platysepalum***
 b. Receptacle narrow. Anthers not V-channeled, filaments \pm subulate **2. *D. indum***
 4a. Leaflets (1–)3–5(–7). Fruits to 4 cm long, apex rounded or acutish **4. *D. kunstleri***
 b. Leaves unifoliolate. Fruits (4–)4.5–5.5 cm long, apex beaked or \pm acuminate **5. *D. procerum***

Subgenus *Dialium*

1. *Dialium hydnocarpoides* de Wit

Dialium hydnocarpoides de Wit, Blumea 7 (1953) 320. — Type: *Neth. Ind. For. Serv.* 185 T. 3P. 541 (L holo; BO), Sumatra.

Dialium praetermissum de Wit, Blumea 7 (1953) 321. — Type: *Neth. Ind. For. Serv.* bb 13951 (BO holo; L), Borneo.

Trees, medium- to large-sized up to c. 30 m, dbh up to 45 cm; buttresses relatively high; twigs greyish brown to dark brown, lenticellate, brownish hairy when young, glabrescent. *Leaves* including petiole (5–)7–20(–24) cm long; petiolules 2–4 mm. *Leaflets* (11–)15–17(–19), elliptic-oblong in middle part of leaf, ovate near petiole, (2.5–)3.5–6(–8.5) by (1.5–)2–3(–3.5) cm, subcoriaceous; apex rounded, obtuse or abruptly acuminate; base usually rounded; surfaces concolorous, rather dull, brownish hairy beneath, glabrescent; nerves (5–)6–9 pairs, rather fine, distinct, reticulation indistinct. *Panicles* terminal, the lower primary branches subtended by reduced or normal leaves, rachis (6–)9–15(–20) cm, densely brownish hairy; pedicels 1–2 mm. *Flowers* white. *Sepals* 5, ovate-lanceolate, 3.5–4 by 1.5–2.5 mm, minutely hairy inside. *Stamens* 2, rarely 3; filaments 1–1.5 mm, glabrous; anthers 2.5–3 mm long, rather flattish on abaxial and adaxial sides, connective hairy on both sides. *Ovary* inserted on a narrow, flattish and patent-hairy receptacle, 1.5–2 mm long; style 1–1.5 mm long, slightly recurved at the top. *Fruits* subglobose, sometimes slightly compressed, 1.5–2 cm in diameter; exocarp brittle, densely and rather persistently, brownish hairy. *Seeds* orbicular, c. 9 by 8 mm; testa chocolate brown, shiny.

Distribution — *Malesia*: S Sumatra, Borneo (Sabah, Kalimantan).

Habitat & Ecology — Primary forest, 20–60 m altitude. Fl. Jan.–July; fr. April–June.

Note — At a glance, the flowers of this species could be mistaken for *Dialium platysepalum* but dissection will show that the receptacle is narrow with a flattish top, and the anthers have a flattish (not V-channeled) abaxial side.

2. *Dialium indum* L.

Dialium indum L., Mant. 1 (1767) 24; Miq., Fl. Ind. Bat. 1, 1 (1855) 79; Ridley, Fl. Malay Penins. 1 (1922) 622; Backer & Bakh. f., Fl. Java 1 (1964) 535; Cockb., Trees Sabah (1976) 167, f. 35. — Type: *Linn. Herb.* 23.1.

Dialium javanicum Burm. f., Fl. Ind. (1768) 12. — Type: not indicated.

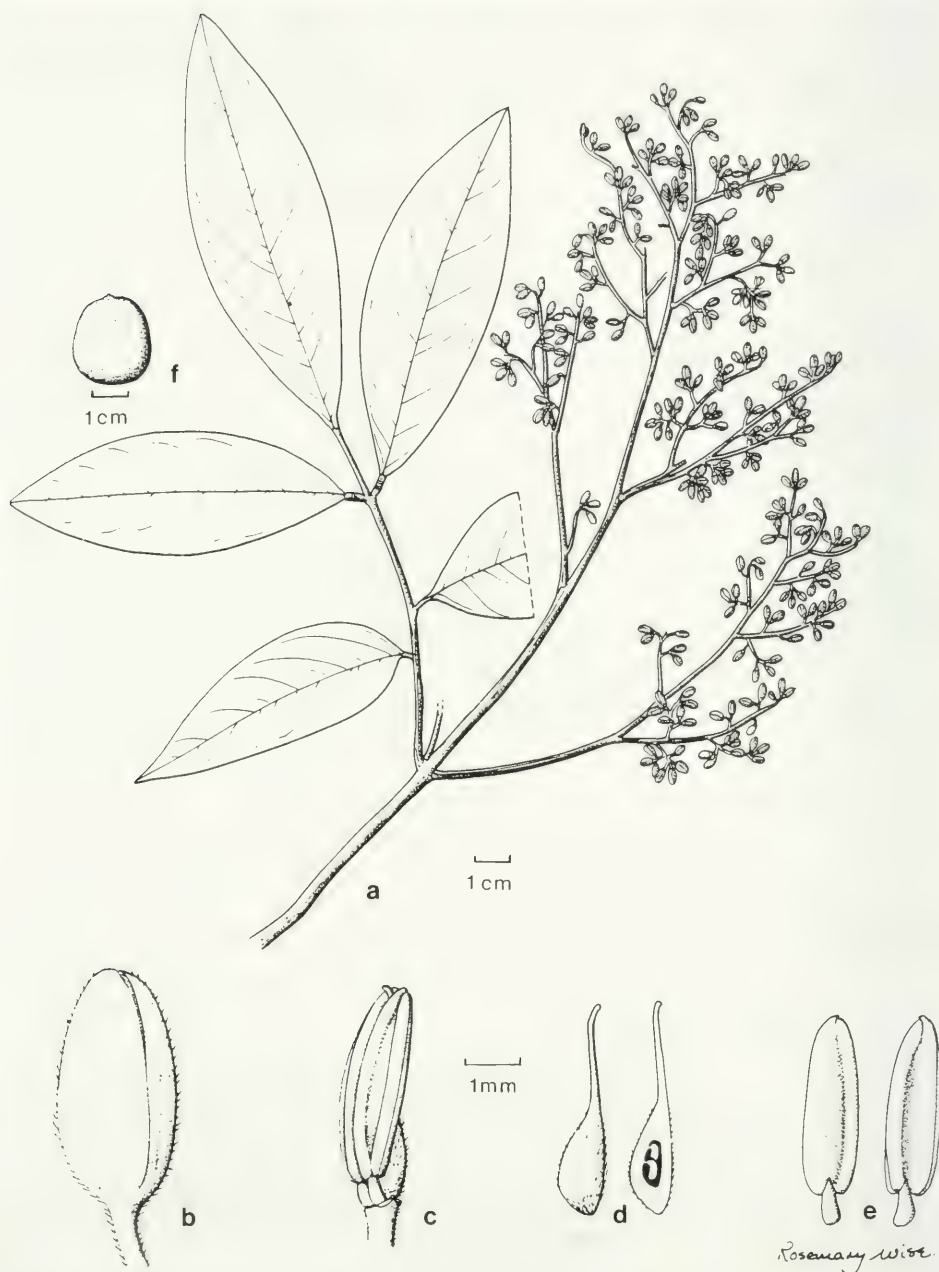


Fig. 30. *Dialium indum* L. a. Flowering branch; b. flower bud; c. flower bud, sepals removed; d. ovary, with section; e. stamens, adaxial and abaxial view; f. fruit (a: Ibrahim s. n.; b–e: FRI 1617; f: SAR 29688). Drawing R. Wise.

Dialium laurinum Baker in Hook. f., Fl. Brit. India 2 (1878) 269; Ridley, Fl. Malay Penins. 1 (1922) 622; Whitmore in Tree Fl. Malaya 1 (1972) 260. — Lectotype: *Maingay 1625* (K holo), Malay Peninsula.

Dialium patens Baker in Hook. f., Fl. Brit. India 2 (1878) 270; Ridley, Fl. Malay Penins. 1 (1922) 622; Whitmore in Tree Fl. Malaya 1 (1972) 260. — Lectotype: *Griffith 1846* (K holo; L), Malay Peninsula.

Dialium angustisepalum Ridley, Kew Bull. (1929) 255. — Type: *Yusop CF 4123* (K holo; L, SING), Malay Peninsula.

Dialium laurinum Baker var. *bursa* de Wit, Blumea 7 (1953) 320. — Type: *Neth. Ind. For. Serv. 186T. 1P.197* (L holo; K), Sumatra.

Dialium marginatum de Wit, Blumea 7 (1953) 320. — Type: *Beccari PB 3381* (K holo; L), Sarawak.

Dialium turbinatum de Wit, Blumea 7 (1953) 321. — Type: *SAN 3782* (K holo; L, P), Sabah.

Trees, up to 40 m high, dbh up to 1 m; twigs rather slender, grey to dark brown, lenticellate, young parts hairy. *Leaves* including petiole (7–)10–15(–20) cm long; petioles (3–)4–6(–10) mm long, late glabrescent. *Leaflets* (5–)7–9(–11), ovate-oblong or ovate-lanceolate to elliptic, (4–)6–10(–11) by (2.5–)3–5(–7) cm, (stiff) coriaceous; apex (long) acuminate to cuspidate, or obtuse to rounded; base rounded to cuneate; surfaces usually concolorous, glabrous above, glabrous to late glabrescent beneath; nerves 8–10(–14) pairs, nervation fine, distinct beneath. *Panicles* terminal, the lower primary branches usually subtended by leaves or in fascicles axillary to fallen leaves, rachis 10–20 cm long; pedicels 2–6 mm. *Flowers* white. *Sepals* 5, ovate-oblong to elliptic, up to 5 by 2.5 mm, minutely hairy inside. *Stamens* 2; filaments up to 1.5 mm long; anthers oblongish, 3.5–4.5(–5) mm long, usually opening before anthesis, connective sparsely hairy on both sides. *Ovary* sessile, up to 2 mm long, white hairy; style short, straight to slightly recurved at top. *Fruits* globose to ovoid, sometimes slightly compressed, 1.5–2 (–2.5) by 1–1.5 cm; exocarp brittle, hairy but not velvety. *Seeds* squarish to reniform, 7–12 by 5 mm, testa light to dark brown, shiny. — **Fig. 30.**

Distribution — Southernmost Thailand; *Malesia*: Western part.

Note — Two varieties can be recognized and identified fairly accurately. There are, however, intermediates.

KEY TO THE VARIETIES

- a. Leaflets ovate-oblong to ovate-lanceolate, subcoriaceous, apex usually long acuminate to cuspidate, nerves and reticulations distinct but slightly raised **a. var. *indum***
- b. Leaflets broadly elliptic, sometimes roundish or broadly lanceolate, stiff coriaceous, apex obtuse to abruptly acuminate, nerves and reticulations prominently raised beneath **b. var. *bursa***

a. var. *indum*

Dialium indum L. — *Dialium javanicum* Burm. f. — *Dialium patens* Baker — *Dialium angustisepalum* Ridley — *Dialium marginatum* de Wit — *Dialium turbinatum* de Wit.

Distribution — Thailand, southern part; *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Java.

Habitat & Ecology — Low, well-drained flat country and hills, sometimes in swampy areas including peat swamp (Whitmore, l.c.), up to c. 1150 m altitude. Fl. throughout the year, peaks Feb.–June; fr. peaks in May, Aug., Oct.

Notes — 1. *Dialium cochinchinense* Pierre, a continental species, was recorded as cultivated in some villages in Peninsular Malaysia (Whitmore, l.c.), but I did not come across any material.

2. Merrill [Interpr. Rumph. (1917) 257] interpreted *Tamarindus altera* Rumph. [Herb. Amb. 2 (1741) 93] as the present species.

b. var. *bursa* (de Wit) Rojo

Dialium indum L. var. *bursa* (de Wit) Rojo, nov. comb. — *Dialium laurinum* Baker var. *bursa* de Wit, Blumea 7 (1953) 320.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Singapore, Borneo.

Habitat & Ecology — As the other variety, but not reported from swampy areas.

Note — The type specimen of *D. laurinum* is intermediate between the two varieties.

3. *Dialium platysepalum* Baker

Dialium platysepalum Baker in Hook. f., Fl. Brit. India 2 (1878) 270; Ridley, Fl. Malay Penins. 1 (1922) 623; Whitmore in Tree Fl. Malaya 1 (1972) 261, f. 7. — Lectotype: *Griffith 1847* (K holo), Malay Peninsula.

Dialium platypetalum Baker var. *wallichii* Baker in Hook. f., Fl. Brit. India 2 (1878) 270. — *Dialium wallichii* (Baker) Prain, J. As. Soc. Beng. 66, ii (1897) 174; Ridley, Fl. Malay Penins. 1 (1922) 623; Whitmore in Tree Fl. Malaya 1 (1972) 261; Cockb., Trees Sabah (1976) 169, f. 35. — Lectotype: *Wallich 8534* (K holo), Singapore.

Dialium platysepalum Baker var. *papan* Prain, J. As. Soc. Beng. 66, ii (1897) 173. — Lectotype: *Good-enough 1553* (SING holo), Malay Peninsula.

Dialium platysepalum Baker var. *burong* Prain, J. As. Soc. Beng. 66, ii (1897) 173. — Lectotype: *Holmberg 855* (SING holo), Malay Peninsula.

Dialium maingayi Baker in Hook. f., Fl. Brit. India 2 (1878) 269; Ridley, Fl. Malay Penins. 1 (1922) 622; Whitmore in Tree Fl. Malaya 1 (1972) 260. — Lectotype: *Maingay 1398*, excl. fruit bearing specimen (K holo), Singapore.

Dialium ambiguum Prain, J. As. Soc. Beng. 66, ii (1897) 172. — *Dialium platysepalum* Baker var. *ambiguum* (Prain) Ridley, Fl. Malay Penins. 1 (1922) 623. — Lectotype: *Kunstler 6142* (K holo; SING), Malay Peninsula.

Dialium kingii Prain, J. As. Soc. Beng. 66, ii (1897) 175; Ridley, Fl. Malay Penins. 1 (1922) 624; Whitmore in Tree Fl. Malaya 1 (1972) 259. — Lectotype: *Kunstler 8187* (K holo), Malay Peninsula.

Dialium havilandii Ridley, Kew Bull. (1929) 255. — Type: *Haviland 1700* (K holo), Sarawak.

Dialium triste de Wit, Blumea 7 (1953) 321. — Type: *Daud & Tachun SFN 35743* (SING holo), Sarawak.

Trees, up to 45 m and 90–120 cm dbh; twigs greyish brown to rusty-brown, young parts brownish hairy. *Leaves* including petiole (10–)15–24(–28) cm long; petiolules 2–4.5 mm. *Leaflets* (5–)7–11(–15) pairs, oblong-elliptic to -lanceolate, (5–)6–8(–15) by (1.5–)2–4(–7) cm, (sub)coriaceous, hairy, sometimes late glabrescent; apex abruptly to long acuminate, acumen up to 2 cm; base rounded to cuneate; upper surface dark brown when dry, lower surface chocolate brown to rusty brown; nerves 10–12(–15) pairs, dis-

tinct on both surfaces, sometimes obscured below by thick, golden hairs. *Panicles* terminal, the lower branches usually subtended by leaves, rachis 10–15(–30) cm, usually rusty brown; pedicels (2–)2.5–4(–7) mm. *Flower* buds up to 7.5 mm long. *Sepals* 5, triangular, to 6 by 4 mm, minutely hairy inside. *Stamens* 2; filaments 1–2.5 mm long; anthers with both slits drawn towards the abaxial side, forming a V-channel on the abaxial side of the connective, 3–4(–5) mm long, hairy. *Ovary* 2–3.5 mm long; style sharply recurved at top, up to c. 3 mm long, usually sparsely hairy on lower half. *Fruits* subglobose to obovoid, sometimes slightly compressed, (1.5–)2–2.5(–3) cm long, sometimes up to 2 mm stipitate; pericarp firm, exocarp densely brown velvety, persistent. *Seeds* 1(–2), roundish to reniform, 3–13 by 9 mm, testa light brown to blackish, shiny.

Distribution — *Malesia*: Peninsular Malaysia, Singapore, Sumatra, Borneo.

Habitat & Ecology — Usually in low-lying areas and hills, up to c. 500 m altitude. Also in freshwater swamp forest. Flowers throughout the year, with peaks in Dec.–Mar. and May–Sept., fruits heaviest in July–Oct.

Notes — 1. This species is distinct from all other species of *Dialium*. Mature flower buds as well as anthers are the largest in the genus. The base of the flower bud is usually incurved appearing distinctly zygomorphic, and the receptacle is deeply concave with filaments and ovary inserted excentrically on opposite sides.

2. By the size of the leaflets and colour and quality of the indumentum on their under-surface the species can be segregated into more or less discrete 'groups'. The '*main-gayi*' group has a rather whitish to slightly golden indumentum underneath, the nerves are not very distinct. The '*platysepalum*' group is the most common group, but not easily separated from the previous one; the leaves are often tinged golden underneath. Leaves in the '*wallichii*' group are slightly golden or light yellow beneath but the blades are smaller, not more than 7 by 2 cm. In the '*kingii*' group leaves are slightly larger than in '*wallichii*', the undersurface is golden to chocolate brown, the nerves are prominent. In the '*triste*' group the chocolate brown leaves are still larger and the nerves much more prominent. The differences between the 'groups' are slight and they form a gradient with intermediate specimens, so they are given no taxonomic and nomenclatural status.

Subgenus *Dansera* (Steenis) Steyaert

4. *Dialium kunstleri* Prain

Dialium kunstleri Prain, J. As. Soc. Beng. 66, ii (1897) 168; Ridley, Fl. Malay Penins. 1 (1922) 621;

Whitmore in Tree Fl. Malaya 1 (1972) 259. — Type: *Kunstler 4415* (K holotype; BM), Malay Peninsula.

Dialium dewitiei Steenis, Bull. Bot. Gard. Buitenzorg III, 17 (1948) 415, nom. nud.

Dialium silvestre de Wit, Blumea 7 (1953) 321. — Type: *Neth. Ind. For. Serv. bb 12957* (BO holotype; L), Borneo.

Dialium trifoliolatum de Wit, Blumea 7 (1953) 321. — Type: see below.

Large trees, to 40 m high and 90 cm dbh; twigs pale or greyish to dark brown, lenticellate, hairy when young. *Leaves* including petiole up to 5 cm long; petiolules 3–4(–7) mm long. *Leaflets* 3–5(–7), compound leaves often mixed with unifoliolate ones, elliptic, elliptic-oblong or ovate to lanceolate, (4–)5–15(–19) by (2–)3–6(–7.5) cm, coriaceous.

ceous; apex long acuminate to acute; base cuneate or rounded; surfaces concolorous, dark brown when dry, glabrous above, glabrescent beneath; nerves (5–)6–8(–9) pairs, sharply arcuating towards apex, rather distinct. *Panicles* usually axillary, mostly in few fascicles, rarely terminal, rachis (4–)6–12(–20) cm, sparsely hairy; pedicels (2–)3–4 mm long. *Sepals* 3, elliptic-oblong, c. 3.5 by 2–2.5 mm, minutely hairy inside. *Stamens* 6; filaments 1–1.5 mm long; anthers linear, 3–3.5 mm long, sometimes hairy along both sides of the connective. *Ovary* c. 1.5 mm long, whitish hairy; style 1.5–2 mm, slightly recurved at apex. *Fruits* broadly ellipsoid to ovoid, 3–4 by 2.5–3 cm, mucro sometimes persistent; pericarp rather thick and firm, exocarp glabrescent with age. *Seeds* (sub)orbicular, flattish, c. 1.5 by 1 cm, testa chocolate brown to blackish.

Distribution — *Malesia*: Peninsular Malaysia, Borneo.

KEY TO THE VARIETIES

- a. Leaflets 5, sometimes together with 3 or very rarely 7 in leaves on the same twig **a. var. *kunstleri***
- b. Leaflets 3, often together with unifoliolate leaves on the same twig **b. var. *trifoliolatum***

a. var. *kunstleri*

Dialium kunstleri Prain — *Dialium silvestre* de Wit.

Leaves (4–)5–12(–17) by 2–5(–6.5) cm, with the nerves prominent but not distinctly raised beneath.

Distribution — *Malesia*: Peninsular Malaysia (seemingly rare), Borneo (very common).

Habitat — Primary forest, altitude 30–250 m, in Sarawak also (once) collected in kerangas forest.

Ecology — Fl. May, Nov.; fr. June, Oct.–Nov.

b. var. *trifoliolatum* (de Wit) Rojo

Dialium kunstleri Prain var. *trifoliolatum* (de Wit) Rojo, stat. et var. nov. — *Dialium trifoliolatum* de Wit, Blumea 7 (1953) 321. — Type: *Neth. Ind. For. Serv. bb 19826* (BO holo; L, SING), Kalimantan.

Leaves (5–)6–15(–19) by (2–)3–6(–7.5) cm, nerves very distinctly raised beneath.

Distribution — *Malesia*: Peninsular Malaysia, Borneo.

Habitat & Ecology — As in type variety.

5. *Dialium procerum* (Steenis) Steyaert

Dialium procerum (Steenis) Steyaert, Reinwardtia 2 (1953) 355; Whitmore in Tree Fl. Malaya I (1972) 261. — *Dansera procera* Steenis, Bull. Bot. Gard. Buitenzorg III, 17 (1948) 415. — Type: *Neth. Ind. For. Serv. 117T.3P.390* (L holo; BO), Sumatra.

Rhynchocarpa monophylla Backer ex K. Heyne, Nutt. Pl. Ned. Indië (1927) 739, nom. nud.

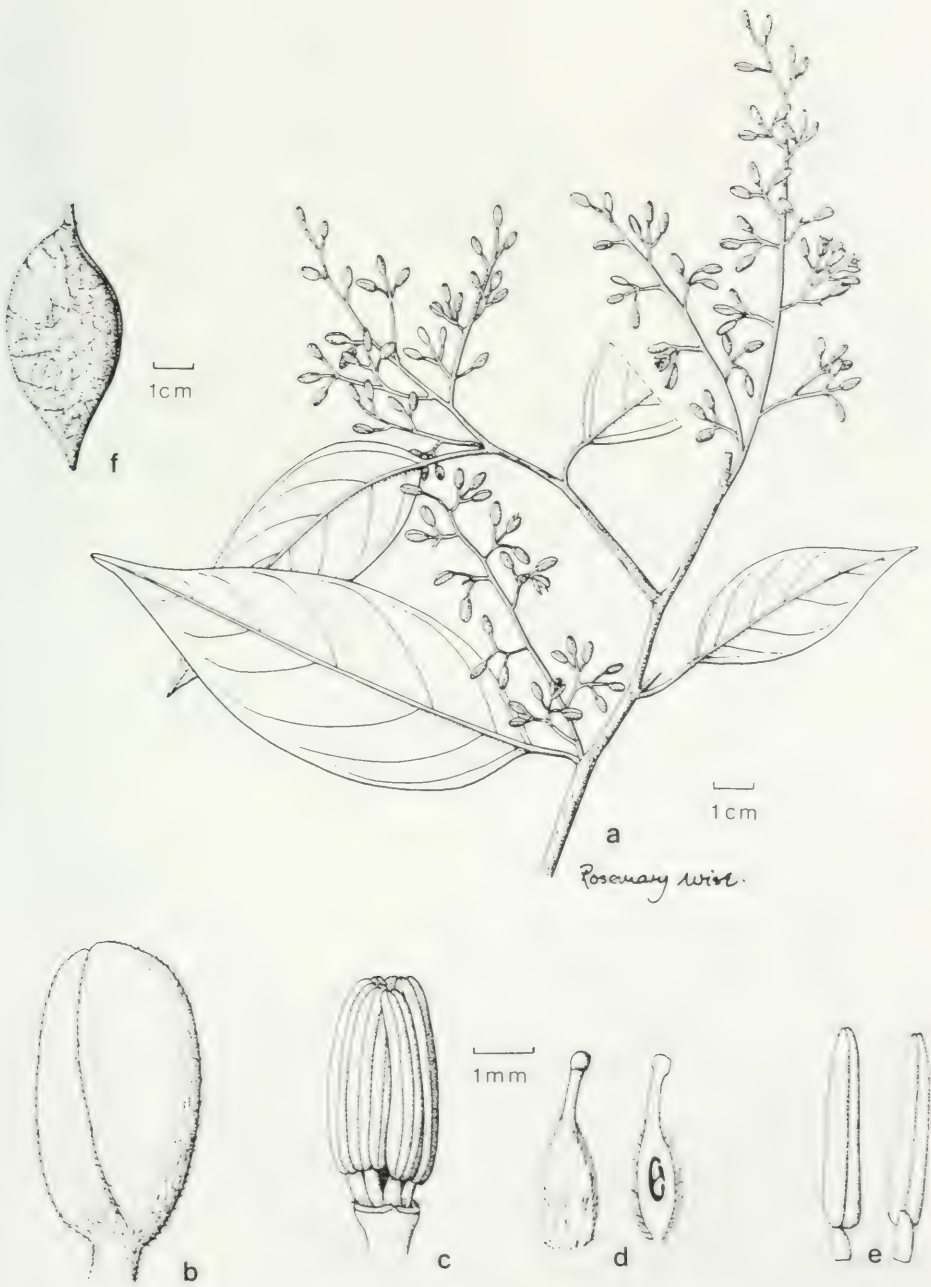


Fig. 31. *Dialium procerum* (Steenis) Steyaert. a. Flowering branch; b. flower bud; c. flower bud, sepals removed; d. ovary, with section; e. stamens, adaxial and abaxial view; f. fruit (a: 117T.3P.390; b–c: T. 579 16/10; f: BRUN 856). Drawing R. Wise.

Large trees, up to 45 m high and 90 cm dbh; twigs light to greyish brown, lenticellate, hairy when young, soon glabrescent. *Leaves* unifoliolate; petiole (0.5–)1–3 mm long only, petiolule as long as the petiole, glabrescent. *Leaflets* ovate to ovate-oblong or elliptic, 6.5–16 by 3.5–7 cm, coriaceous; apex bluntly acuminate, often folded when dried; base rounded to cuneate; surfaces concolorous, above often shiny, glabrous, beneath dull, glabrescent; nerves (5–)6–8(–9) pairs, the upper ones sharply arcuating towards the apex, reticulation distinct. *Panicles* axillary or (especially in side branches) terminal, sometimes in fascicles, rachis (6–)9–15(–16) cm; pedicels 2–4 mm long. *Sepals* 3, elliptic, 3–4 mm long, minutely hairy inside. *Stamens* 6; filaments 0.5–1 mm long; anthers linear, c. 2.5 mm long, glabrous or hairy on both sides of the connective. *Ovary* 1.5–2 mm long; style 0.5–1 mm, slightly recurved at apex. *Fruits* ovoid, c. 4(–5) by 2.5 cm, slightly compressed, with distinct sulcate sutures, usually acute to cuneate at base, beaked or apiculate at apex; exocarp blackish, hairs easily detached and glabrescent. *Seeds* reniform, c. 1.5 by 1 cm, testa chocolate brown, shiny. — **Fig. 31.**

Distribution — *Malesia*: Peninsular Malaysia, Sumatra, Borneo (Sarawak, Brunei).

Habitat & Ecology — Primary and old secondary forest, sometimes inundated, altitude 15–560 m. Fl. June–Mar; fr. Jan.–April.

Notes — 1. This is a homogeneous species except in the size of the leaves.

2. The species is very close to *D. kunstleri*, especially its var. *trifoliolatum*.

ENDERTIA

(Ding Hou)

Endertia Steenis & de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1947) 323; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 26. — Type species: *Endertia spectabilis* Steenis & de Wit.

Trees. *Stipules* small, axillary, caducous. *Leaves* spiral, paripinnate, 2–4-jugate. *Leaflets* opposite or subopposite, petiolulate. *Inflorescences* axillary or terminal, solitary or mostly in fascicles, paniculate; bracts and bracteoles small, deciduous or persistent. *Flowers* bisexual, pedicelled, zygomorphic, articulated at the base, easily falling off. *Hypanthium* infundibuliform. *Calyx* lobes 4, imbricate. *Petals* 2 developed, lateral, clawed at the base, and with 1 or 2, minute, reduced ones (at abaxial side). *Stamens* 2 fertile, opposite the developed petals; filaments filiform, dilated at basal parts and united with the staminodes to form an unequal, very short, incomplete ring (which is sometimes 1–3-tipped or toothed and with 1 or 2 minute staminodes in the gap between the two ends of the ring); anthers oblong, longitudinally splitting. *Ovary* with an almost free stipe (or only the basal part united with the floral tube), oblong, flat, 2–5-ovuled; style filiform, recurvate; stigma capitate. *Pods* hatchet-shaped, woody, 2-valved, the valves finally coiling into a closed spiral. *Seeds* flat, disc-shaped.

Distribution — Monotypic. *Malesia*: Borneo (Kalimantan).

Habitat — In lowland forest.



Fig. 32. *Endertia spectabilis* Steenis & de Wit. a. Flowering branch; b. flower; c. flower with calyx lobes and fertile stamens; d. valve of opened pod; e. seed. Reproduced from Bull. Bot. Gard. Buitenzorg III, 17.



Fig. 33. *Endertia spectabilis* Steenis & De Wit. Flowering branch. Cultivated in Botanic Garden, Bogor as nr. I-B-90. Photographer unknown.

***Endertia spectabilis* Steenis & de Wit**

Endertia spectabilis Steenis & de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1947) 324, f. l. — Syn-types: *Nieuwenhuis* 947 (BO), Kalimantan; *Anonymus s.n.* (BO), cult. Java, Bot. Gard. Bogor, no. I-B-90, origin Kalimantan, collected in 1930. See note.

Tree up to 20–35(–80) m high, 37–50(100) cm in diam., not or hardly buttressed. *Leaves* 2–4-jugate; petiole and rachis 7–24 cm long, glabrous. *Leaflets* chartaceous to subcoriaceous, elliptic, ovate, or broadly elliptic, sometimes obovate, 10–23 by 5–9.6 cm; apex shortly acuminate or acuminate, sometimes caudate; base obtuse, rotund, or slightly cuneate, rarely attenuate; glabrous on both surfaces; nerves 7–9 per side; veins obscurely reticulate on both surfaces; petiolules 5–8(–11) mm. *Inflorescences* usually 10–20(–26) cm long, puberulous; bracts and bracteoles triangular or deltoid, c. 1 mm long; pedicels 4–12 mm, articulated at the apical end. *Hypanthium* 4–7 mm long, puberulous outside, glabrous inside. *Flowers* white. *Calyx* lobes 4, ovate, oblong-elliptic, or suborbiculate, 3–4 mm long, puberulous outside, subglabrous inside. *Petals* white or light yellowish when young, then red orange, suborbicular, obovate, flabellate, 4.5–5 by 2.5–4 mm, with distinct lateral veins, clawed at the basal part (c. 1 mm long), glabrous except ciliate on the margin. *Stamens* and staminodes 1.5–8 mm. *Ovary* 3 mm long, hirsute to densely lanate, sometimes only along the sutures, glabrescent or glabrous in the central part; style 4.5–5.5 mm. *Pods* up to 26 (or more) by 4–7 cm, distinctly veined when young, smooth or nearly so when old. *Seeds* 3–4.2 by 3 cm.

Distribution — *Malesia*: Borneo (Kalimantan). — **Fig. 32, 33.**

Habitat & Ecology — In lowland forest, sometimes found occurring on sandy, loam soil, or on limestone, up to 1000 m altitude. Fl. April, Oct.; fr. Feb. Oct. Nov.

Note — Van Steenis & De Wit (l.c.) cited the type for their new species *Endertia spectabilis* as “*Nieuwenhuis* 947 (18.V.1897), cultivated in Hort. Bot. sub I.B.90, collected in 1930.” There is one herbarium specimen of *Nieuwenhuis* 947 in BO, as Dr Elizabeth Widjaja (in litt.) informed me. This specimen and the one collected in 1930 from the tree that originated from *Nieuwenhuis*’ collection from Kalimantan, cultivated under no. I-B-90 in the Botanic Garden Bogor, can be considered as authentic material of *Endertia spectabilis*, so both are treated here as syntypes. Several good fertile specimens were in the course of time collected from the same tree in the Garden and some herbarium specimens were also collected from the wild in Borneo.

GLEDITSIA

(Ding Hou)

Gleditsia L., Sp. Pl. (1753) 1056; Gen. Pl., ed. 5 (1754) 476; DC., Prodr. 2 (1825) 479 (*‘Gleditschia’*); Benth. in Benth. & Hook. f., Gen. Pl. 2 (1865) 568 (*‘Gleditschia’*); Robertson & Lee, J. Arnold Arbor. 57 (1976) 26; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 87; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 29. — Type species: *Gleditsia triacanthos* L.

Trees, trunks and branches armed with simple or branched thorns. *Stipules* minute, caducous. *Leaves* pinnate and/or bipinnate. *Leaflets* subopposite or alternate, slightly asymmetric, often with crenate margin. *Inflorescences* axillary, racemose, solitary or fasciculate, rarely panicle; bracts and bracteoles absent at anthesis; pedicels articulate. *Flowers* perfect or imperfect, unisexual or bisexual, the plants dioecious or polygamous. *Hypanthium* campanulate, lined with nectariferous tissue. *Calyx* 3–5-lobed, subequal.

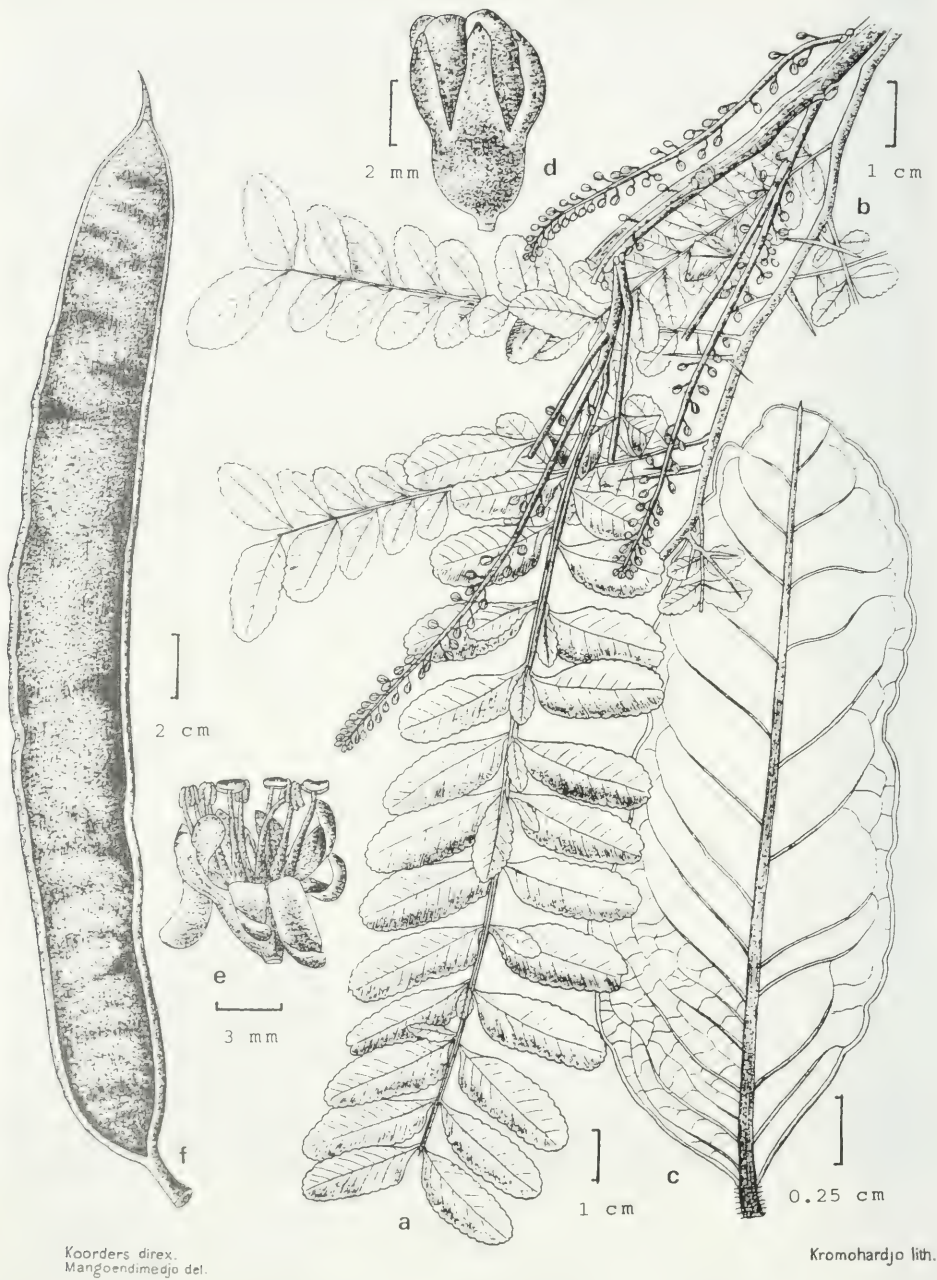


Fig. 34. *Gleditsia rolfei* Vidal. a. Flowering branch; b. leafy branch; c. apical leaflet, lower surface; d. flower bud; e. flower; f. pod. Reproduced from Koorders, Suppl. Fl. NO Celebes: t. 3a & 3b.

Petals 3–5, subequal, imbricate, not clawed. *Stamens* 5–10, exerted in male and bisexual flowers, reduced in female; filaments free, more or less equal; anthers longitudinally dehiscent. *Ovary* subsessile in female or bisexual flowers, rudimentary or absent in male, 2–30-ovuled; style short; stigma terminal, often 2-lobed. *Pods* indehiscent or tardily dehiscent, oblong or elongate, compressed, more or less coriaceous, 1–many-seeded. *Seeds* transverse, broadly ellipsoid to subquadrate, compressed, albuminous.

Distribution — About 14 species, 2 or 3 in eastern North America, 1 in southern South America, c. 1 around the Caspian Sea, 1 in *Malesia* (Philippines and Celebes), the rest in India, Laos, Vietnam, China, Korea, and Japan.

Note — The original spelling of the generic name *Gleditsia* is to be retained and is not to be altered to *Gleditschia*. See International Code of Botanical Nomenclature (1994) Art. 60.7, Ex. 9.

***Gleditsia rolfei* Vidal**

Gleditsia rolfei Vidal, Rev. Pl. Vasc. Filip. (1886) 115 ('*Gleditschia*'); Merr., Philipp. J. Sc., Suppl. 1 (1906) 63; Philipp. J. Sc., Bot. 5 (1910) 51; Koord.-Schum., Syst. Verzeichn. 3 (1914) 54; Koord., Suppl. Fl. N.O. Celebes (1918) 10, t. 3a & 3b; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 265; Huang & Ohashi in Fl. Taiwan 3 (1977) 293; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 70, pl. 12/5–8. — Type: Vidal 1826 (K), Luzon.

Gleditsia celebica Koord., Fl. N.O. Celebes (1898) 433 ('*Gleditschia*'); Merr., Bull. Bur. For. Philipp. Islands 1 (1903) 24. — Syntypes: *Koorders 16855–16862, 29480* (BO holo; most iso in L), Celebes.

Tree 20–22 m tall, 40–45 cm in diam., trunks with stout thorns up to c. 8 cm long; young branches with supra-axillary thorns up to 1 cm long. *Leaves* 10–24 cm long; shortly petioled, both petiole and rachis sparsely puberulous; petiolules short. *Leaflets* up to c. 26 per pinna or on a simply pinnate leaf, coriaceous, oblong, rhomboid-oblong, or lanceolate, 2.5–7 by 1–2.5 cm, slightly unequal-sided; apex mucronate or slightly notched; base acute; margin slightly irregularly crenate; glabrous on both surfaces; nerves c. 10 per side. *Inflorescences* up to c. 9 cm long; pedicels 3–5 mm. *Flowers* puberulous outside. *Hypanthium* short, c. 2 mm long. *Calyx* lobes 5, lanceolate, slightly imbricate, 3–3.5 mm long. *Petals* 5, white, similar to calyx lobes in shape and size. *Stamens* 10; filaments subulate, apical part inflexed, pilose except the apical part; anthers versatile, 1.3 mm long, apiculate; reduced to staminodes in female flowers. *Ovary* covered with appressed hairs, c. 20-ovuled; pistil reduced in male flowers, filiform or obscure. *Pods* (10–)20–26 by 2–3 cm. *Seeds* up to c. 20, ellipsoid, compressed, c. 12 by 6 mm. — **Fig. 34.**

Distribution — Vietnam, Laos, Taiwan; *Malesia*: Philippines (Luzon, Samar, Negros, Mindanao), Celebes (Minahasa, Maros, Mt Bonthain).

Habitat & Ecology — In rain forest, up to 250(–900) m altitude. Fl. Feb., Sept., Oct.; fr. Feb., April, May, Aug., Sept., Dec.

Uses — Wood suitable for house building material.

Note — Koorders (l.c. 1898) based his new species *Gleditsia celebica* exclusively on his own collections from NE Celebes (Minahasa) in the 'Mus. Hort. Bogor' (now

BO) without citation of specimens and without designation of the type. The species was later treated as a synonym of *G. rolfei* in the publications of Koorders-Schumacher (l.c.) and Koorders (l.c. 1918). The Koorders collections were then cited under that species. These collections obviously belong to the authentic material of *G. celebica*, so they may be (all) considered as the syntypes. So far I have not found any published lectotypification of the name.

INTSIA

(Ding Hou)

Intsia Thouars, Gen. Nov. Madag. (1806) 22; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 35; Ding Hou, Blumea 38 (1994) 322. — Type species (Hutchinson 1964): *Intsia madagascariensis* Thouars ex DC. [= *Intsia bijuga* (Colebr.) Kuntze].

Trees often with buttresses. *Stipules* intrapetiolar, connate. *Leaves* paripinnate. *Leaflets* chartaceous to subcoriaceous, usually with 1 or 2 small crateriform glands at the basal part on lower surface; petiolules twisted. *Inflorescences* terminal or axillary, simply racemose, often fasciculate, or paniculate; bracts caducous. *Flowers* bisexual, zygomorphic. *Hypanthium* cupular, narrowly infundibuliform or cylindric. *Calyx* lobes 4. *Petals*: only 1 fully developed, flabellate, lower half narrowed into a claw, the others rudimentary or absent. *Disk* absent. *Stamens* 3 or very rarely 4 fertile; staminodes 4–7; filaments and staminodes connate at the base; anthers dorsifixed. *Ovary* stipitate (stipe adnate to the hypanthium except the apical part), puberulous; style slender; stigma small, capitellate. *Pods* oblong, rarely obcordate, straight or falcate, flattened, glabrous, dehiscent, 2-valved (valves leathery or slightly woody), often 3- (or more-)seeded. *Seeds* ovoid, oblong, discoid, or sublenticular, flattened, not arillate, scurfy, exalbuminous.

Distribution — Species 2 or more, from Madagascar, islands in Indian Ocean, tropical Asia, through *Malesia* to N Australia, Melanesia and Micronesia. In *Malesia* 2 species.

Habitat — See under the species.

Uses — The timber (international trade name *merbau*) has a wide range of uses both indoors and outdoors, the main source of merbau timber being *Intsia palembanica*. See Vink in Ding Hou, Blumea 38 (1994) 322–323; R.J. Johns et al. in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 264–270.

KEY TO THE SPECIES

- a. Leaves 2- (or 3-)jugate, rarely 1-jugate towards the top of twigs or below the inflorescences. Hypanthium 6–10(–16) mm long, usually about the same length as the calyx lobes. Style c. 4 cm. Pods 8.5–15(–28) by 4–5(–7.2) cm **1. *I. bijuga***
- b. Leaves 4-jugate, rarely associated with some 2-, 3- or 5-jugate ones. Hypanthium 3–4 mm long, shorter than the calyx lobes (usually 6–8 mm long). Style 2–3.5 cm. Pods 15–19(–40) by 6–7(–9) cm **2. *I. palembanica***

1. *Intsia bijuga* (Colebr.) Kuntze

Intsia bijuga (Colebr.) Kuntze, Rev. Gen. Pl. 1 (1891) 192; Prain, Sc. Mem. Med. Off. Army India 2 (1901) 44, f. 12–16; Ding Hou, Blumea 38 (1994) 324, f. 1. — *Macrobium bijugum* Colebr., Trans. Linn. Soc. 12 (1818) 359, t. 17. — *Outea bijuga* DC., Prodr. 2 (1825) 511. — Type: Colebrooke's plate.

Intsia madagascariensis Thouars ex DC., Prodr. 2 (1825) 509. — Type: Based on description of *Intsia* Thouars (1806).

Intsia? *amboinensis* DC., Prodr. 2 (1825) 509; Miq., Fl. Ind. Bat. 1, 1 (1855) 80; *ibid.*, Suppl. (1860/61) 107, 288. — *Macrobium amboinense* Teijsm. ex Hassk., Abh. Naturf. Ges. Halle 9 (1866) 189. — Type: Plate of *Metrosideros amboinensis* in Rumph., Herb. Amb. 3 (1750) 21, t. 10.

For a complete list of synonyms and references, see Ding Hou, Blumea 38 (1994) 324.

Tree up to 40 m high and 1 m in diam.; buttresses when present up to 2(–4) m high and c. 2 m wide. *Leaves* 2- (or 3-)jugate, rarely 1-jugate towards the top of twigs or below the inflorescences; petiole and rachis (1.5–)2.5–11.5 cm long, glabrous. *Leaflets* (broadly) elliptic, ovate, obovate, rarely suborbiculate, (2.5–)5–10(–18) by (1.5–)4–6(–12) cm; apex obtuse, rounded, sometimes shortly acuminate, rarely slightly notched; base acute, cuneate, or obtuse, often slightly asymmetric; petiolules 2–6 mm. *Inflorescences* up to 10(–17) cm long, pubescent, glabrescent, or more or less glabrous; pedicels 7–12 mm. *Hypanthium* usually about the same length as the calyx lobes. *Calyx* lobes elliptic, 6–10(–16) by 4–5(–7.5) mm. *Petal*: limb 6–10(–30) by 10–15(–35) mm; claw c. 5 mm long. Fertile *stamens*: filaments c. 3 cm; anthers c. 2 mm long; staminodes up to 10 mm. *Ovary* c. 7.5 mm long; style c. 4 cm. *Pods* 8.5–15(–28) by 4–5(–7.2) cm. *Seeds* 2–3.5 cm long and wide, c. 0.8 cm thick. — **Fig. 35e.**

Distribution — As the genus.

Habitat & Ecology — Along (sandy) sea coasts, river edgess, tidal or temporarily inundated places with (salty) water, back-mangroves, in primary and secondary forests, in Kalimantan once found on acid, sandy soil; recorded from some places in Irian Jaya to be (very) common, from sea level to c. 600 m altitude. Fl. and fr. throughout the year.

Uses — See under the genus.

2. *Intsia palembanica* Miq.

Intsia palembanica Miq., Fl. Ind. Bat., Suppl. (1860) 107, nomen; (1861) 289, descr.; Ding Hou, Blumea 38 (1994) 326, f. 1. — *Azelia palembanica* (Miq.) Baker in Hook. f., Fl. Brit. India 2 (1878) 275. — Lectotype (Ding Hou 1994): *Teijsmann 4535* (U holo; L photo), Sumatra; syntypes: *Teijsmann HB 3666*, *HB 3820*, *HB 3914* and *HB 4315* (U, photos in L), Sumatra.

Intsia plurijuga Harms, Bot. Jahrb. 55 (1917) 54. — Syntypes: *Ledermann 7441 & 8652* (K, photos in L), *Schlechter 14219* (K, photo in L), New Guinea.

Intsia acuminata auct. non Merr.: Verde., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 90.

Tree up to 45 m (rarely more) high and 4 m (once recorded) in diam.; buttresses up to 7 m high, extending outwards 6 m, 30 cm thick. *Leaves* 4-jugate, rarely associated with some 2-, 3-, or 5-jugate; petiole and rachis (3.5–)9.5–17.5(–26) cm, both puberulous, glabrescent. *Leaflets* ovate, elliptic, sometimes broad-ovate or -elliptic, or suborbicular, rarely obovate or lanceolate, (3–)10–13.5(–18.5) by (3–)5–7.5(–10.5) cm; apex obtuse or rounded, sometimes slightly notched, (shortly) acuminate; base obtuse.

Ding Hou, '95



Fig. 35. *Intsia palembanica* Miq. a. Flowering branch; b. flower with one calyx lobe removed; c. pod; d. seed (a: *Koster BW 11084*; b: *van Royen 5007*; c, d: *Meijer SAN 19871*). Drawing Ding Hou. — *Intsia bijuga* (Colebr.) Kuntze. e. Floral diagram, after Prain, Sc. Mem. Med. Off. Army India 12: f. 12.

rounded, cuneate, rarely slightly truncate or subcordate, often somewhat asymmetric; nerves 6–10 per side; petiolules 2–5 mm. *Inflorescences* up to c. 10 cm long, pubescent, glabrescent; pedicels 3–12 mm. *Hypanthium* 3–4 mm long. *Calyx* lobes (broadly) elliptic, ovate, or slightly obovate, 6–8(–12) by 3–6.5(–8) mm. *Petal*: limb 3–6(–10) by 3–6.5(–8) mm; claw 2–5 mm long. Fertile *stamens*: filaments 2–4 cm; anthers c. 3 mm long; staminodes 4–10 mm. *Ovary* 5–6 mm long; style 2–3.5 cm. *Pods* 15–19 (–40) by 5.5–7(–9) cm. *Seeds* 3–4.5 by 1.5–3 cm, 0.5–1.2 cm thick. — **Fig. 35a–d.**

Distribution — India (Andamans), Burma, Thailand; throughout *Malesia* (except Java?).

Habitat & Ecology — Widespread, in coastal regions, edges of seasonal swamps, on inundated lands, locally common to very common (e.g. in Japen I., Irian Jaya), in lowland primary or older secondary forests, sometimes on sandstone and limestone hills, from sea level up to 850 m altitude. Fl. Jan.–April, Aug.–Nov.; fr. Feb.–Dec.

KALAPPPIA

(Ding Hou)

Kalappia Kosterm., Reinwardtia 1 (1952) 451; Hutch., Gen. Flow. Pl. 1 (1964) 229; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 36. — Type species: *Kalappia celebica* Kosterm.

Tall trees. *Stipules*? *Leaves* alternate, imparipinnate, often 5-foliolate. *Leaflets* alternate or sometimes opposite, petiolulate. *Inflorescences* axillary, paniculate; bracts and bracteoles very small, caducous; bracteoles 2, enclosing young flower bud. *Flowers* bisexual, slightly zygomorphic, pedicelled. *Hypanthium* absent. *Calyx* lobes 5, almost free. *Petals* 5, erect-patent, clawed, with the 2 lateral (outermost) ones larger. *Disk* absent. *Stamens* 7–9 (4 or 5 fertile, 2–4 staminodes), unequal, free; anthers basifixed, bent inward horizontally, apex slightly projecting, dehiscing by terminal pores or short slits. *Ovary* sessile, flattened, 3–5-ovuled; style slightly incurved; stigma terminal, obscure. *Pods* oblong, flattened, narrowly winged along the ventral suture, dehiscent, valves thin-coriaceous, 1–3-seeded. *Seeds* flat, disk-like; cotyledons flat.

Distribution — Monotypic, restricted to *Malesia*: Celebes.

Habitat — In lowland forest.

Note — The stamens of this genus number 7–9 (4 or 5 of them fertile and 2–4 staminodial). Hutchinson (l.c.) erroneously described “stamens 10, free, 2 fertile, remainder abortive or reduced to staminodes.”

Kalappia celebica Kosterm.

Kalappia celebica Kosterm., Reinwardtia 1 (1952) 452, f. 1. — Type: Rinan 1 = Neth. Ind. For. Serv. bb 33693 (BO holo; L), Celebes.

Tall tree up to 40 m high and 90 cm in diam.; buttresses up to 3 m high, 2 m extending outward over the ground, 20 cm thick. *Leaves*: petiole and rachis 6.5–12.5 cm, puberulous. *Leaflets* chartaceous, elliptic or obovate, (6–)11–14(–17) by (2.5–)4–6(–8.5)



Fig. 36. *Kalappia celebica* Kosterm. a. Flowering branch; b. flower; c. floral diagram; d. flower with calyx lobes (except the adaxial one), petals and some of the stamens and staminodes removed; e. calyx lobes, the lower one not drawn; f. petals; g. apical part of the anther, showing pores and excrecence (connective); h. pistil; i. pods. Reproduced from Reinwardtia 1.

cm; apex shortly acuminate; base cuneate, rarely obtuse; loosely shortly hairy below, glabrous above; lateral nerves 5–8 on each side, veins closely reticulate; petiolules 5–7 mm, puberulous. *Inflorescences* sometimes branched near the base and appearing fasciculate (2 or 3 in an axil), 5–10(–15) cm long, shortly appressed-hairy, glabrescent; bracts and bracteoles ovate, 2–2.5 mm long; pedicels 2–6 mm. *Flowers* (orange-)yellow. *Calyx* lobes 5, elliptic or oblong, 4–6 by 2–3 mm, densely hairy outside, less so inside. *Petals* 5, obovate or oblanceolate, 7–11 by 2–6 mm, gradually narrowed from upper 1/3 towards the claw-like base, rather thin, with 1 distinct mid-vein and 5 or more lateral, straight veins, obliquely ascending upward, more or less fan-shaped, and branched near the margin. *Stamens*: fertile anthers 1.75–2 mm long; filaments 4.5–7 mm; staminodes up to 3(–5) mm. *Pistil* 5.3–7.5 mm long; ovary about the same length as the style or slightly longer. *Pods* c. 7 by 2 cm, smooth. *Seeds* shortly reniform, 10–11 by 13–15 mm, smooth. — **Fig. 36.**

Distribution — *Malesia*: Celebes, only found around Malili (N Gulf of Bone).

Habitat & Ecology — In lowland forest, scattered, growing from an area behind the sea coast to rather high up in the hills to 300 m altitude. Soil usually rocky and containing iron. Fl. April, May, Dec.; fr. March, May, Dec.

Uses — Locally a valuable timber tree, known as 'kalapi' and in high esteem for ship-building and construction of bridges. It is also sawn into boards and stiles; a variety with a beautiful grain pattern is much sought after for cabinet work (fide Kostermans, l.c.).

KINGIODENDRON

(Ding Hou)

Kingiodendron Harms in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 1 (1897) 194; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 211; Meeuwen, Blumea 18 (1970) 46; Verdc., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 93; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 131; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 36. — Type species: *Kingiodendron pinnatum* (Roxb. ex DC.) Harms.

Medium to large evergreen *trees*, slashed wood usually exuding a green sap. Stipules very small, fugacious, leaving scars. *Leaves* imparipinnate, (1–)3–6- (or 7-)foliolate. *Leaflets* alternate, largely equal-sided, with pellucid dots, glabrous; nerves 7–13 (or more) per side; petiolules annularly wrinkled. *Inflorescences* axillary, racemose, simple, solitary or aggregate, or paniculate, shortly peduncled; rachis and branchlets rather loosely flowered, glabrous or hairy; bracts minute, scale-like, persistent; bracteoles usually 2, minute, often inserted at the base of a flower; pedicels short. *Flowers* bisexual or rarely unisexual (see note 2). *Hypanthium* often absent or obscure. *Sepals* 5, imbricate, usually with transparent dots, ciliate. *Petals* absent. *Disk* distinct in young flowers, connate with the stipe of the ovary, becoming obsolete in the mature flower. *Stamens* 10, bent in bud, hairy at base, exerted at anthesis; anthers medi-dorsifix, lengthwise dehiscent, introrse. *Ovary* sessile or subsessile, hairy, 1-ovuled; style developed or very short, glabrous or hairy. *Pods* variable, often flattened, indehiscent; the pericarp often hard to woody, rarely fleshy but fibrous. *Seeds* with strongly folded cotyledons.

Distribution — Six species distributed in India, the Pacific (Solomon Islands and Fiji), and *Malesia* (Philippines, Moluccas, New Guinea).

Habitat — Evergreen forests, at low and medium altitudes.

Notes — 1. The medium- to large-sized trees of *Kingiodendron* can be easily identified to the genus by a combination of the following characters: 1) slashed wood usually exuding a green sap, 2) leaflets with pellucid dots, 3) indehiscent pods, and 4) strongly folded cotyledons which can be easily observed in a section. However, fertile collections, especially fruiting material, are needed for further study of the species in this group (cf. Verdcourt, l.c.).

2. The flowers of this genus have been described as bisexual. However, some of them appear to be heterostylous, with fertile or (partly) sterile stamens. Verdcourt (l.c.) stated that possible presence of functionally male or female flowers needs investigation.

3. Many sterile specimens have been collected, especially from Irian Jaya, which are so far unidentifiable to species.

4. Knaap-van Meeuwen (l.c.: 49) recorded the species *Kingiodendron platycarpus* Burt from New Guinea and the Solomon Islands. According to Verdcourt [Kew Bull. 32 (1977) 244–245; Manual New Guinea Leg. (1977) 97] this species does, however, not occur there.

KEY TO THE SPECIES

- 1a. Leaves 1–4-foliolate. Inflorescences 8–16 cm long; pedicels 1.8 mm; style distinct, 1.5 mm. Pods ovoid-oblong, 5.7–8 by 4.2–5.5 by 1.5–2.8 cm, more or less scaly; pericarp thick and woody, with 12–25 distinct vertical ribs shown on the outer surface **2. *K. novoguineense***
- b. Leaves often with more leaflets, up to 7-foliolate. Inflorescences (unknown in *K. tenuicarpum*) 3.5–12 cm long; pedicels 0.5–1.5 mm; style usually obsolete, rarely very short, up to c. 1 mm. Pods not as above **2**
- 2a. Pods globose or ovoid, 3.7–5.5 by 3–4.5 by 2–3.5 cm, smooth; pericarp fleshy but fibrous **1. *K. alternifolium***
- b. Pods irregularly ovoid or slightly obovoid, 4.2–4.7 by 3.7–4.2 by 1.5–1.9 cm, densely rugulose; pericarp thin woody **3. *K. tenuicarpum***

1. *Kingiodendron alternifolium* (Elmer) Merr. & Rolfe

Kingiodendron alternifolium (Elmer) Merr. & Rolfe, Philipp. J. Sc., Bot. 4 (1909) 267; Merr., Philipp. J. Sc., Bot. 5 (1910) 38; Walker, For. Brit. Solom. Isl. Prot. (1948) 134; Meeuwen, Blumea 18 (1970) 48, f. 7c–e, p.p.; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 94, f. 21. — *Cynometra alternifolia* Elmer, Leaflet. Philipp. Bot. 1 (1907) 223. — *Hardwickia alternifolia* Elmer, Leaflet. Philipp. Bot. 1 (1908) 362. — Type: *Elmer 7356* ('7366' in Merr. & Rolfe, l.c.) (PNH holo, destroyed; BO iso), Philippines.

Tree 15–32 m high, 14–60 cm in diam. *Leaves* 3–7-foliolate, rachis 8–14 cm; petiolules 4–7 mm. *Leaflets* elliptic, oblong, ovate-oblong or ovate-elliptic, more rarely



Fig. 37. *Kingiodendron alternifolium* (Elmer) Merr. & Rolfe. a. Flowering branch; b. half flower beyond anthesis; c. pod; d. longitudinal section of seed (a: E. F. Solevin FB 27392; b: Brass 8101; c: Merrill 2761; d: FB 12668. Drawing Ding Hou (a), R. van Crevel (b–d), the latter reproduced from Blumea 18.

long-triangular, quite often falcoid, 6–20 by 2.5–8.7(–12) cm; apex acute, acuminate or cuspidate; base rounded or acute. *Inflorescences* 3.5–12 cm long, rachis and branchlets pubescent, glabrescent, rather sturdy and straight; pedicels 0.5–1.5 mm, pubescent, sometimes glabrescent. *Ovary* hairy, glabrescent; the style 1.5–2 mm, glabrous. *Pods* brown, globose or ovoid, 3.7–5.5 by 3–4.5 by 2.1–3.5 cm; pericarp fleshy but fibrous, 2–4 mm thick; stipe 0–1.5 mm. — **Fig. 37.**

Distribution — Solomon Islands (Bougainville, Choiseul, and Guadalcanal), New Britain?; *Malesia*: Philippines (Luzon, Masbate, Negros, Leyte, Samar), New Guinea (Irian Jaya: ?Vogelkop, ?Jayapura; Papua New Guinea: Madang, Morobe and Northern Provinces).

Habitat — In lowland rain forest, flood plains, creeks, up to 690 m altitude.

2. *Kingiodendron novoguineense* Verdc.

Kingiodendron novoguineense Verdc., Kew Bull. 32 (1977) 244; Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 97. — Type: *Henty NGF 28032* (LAE holo; K, L, SING), Papua New Guinea.

Kingiodendron alternifolium auct. non (Elmer) Merr. & Rolfe: Meeuwen, Blumea 18 (1970) 48, quoad coll. New Guinea.

Kingiodendron platycarpum auct. non B.L. Burtt: Meeuwen, Blumea 18 (1970) 49, quoad coll. New Guinea.

Tree 13–30 m high, 25–80(–180) cm in diam., without buttresses. *Leaves* 1–4-foliate, petiolules 4–8 mm. *Leaflets* elliptic or oblong-elliptic, 7–17 by 1.7–8 cm, shortly and obtusely acuminate at the apex, cuneate to rounded at the base, thinly coriaceous. *Inflorescences* elongate, 8–16 cm long, the branchlets up to 8 cm long; rachises and branchlets puberulous; pedicels 1.8 mm. *Sepals* white or greenish, rounded ovate, 2 by 1.5 mm, more or less ciliate. *Stamens* with filaments 3.5 mm, hairy. *Ovary* 1.2 mm long, densely hairy; style obsolete. *Pods* ovate-oblong, 5.7–8 by 4.2–5.5 by 1.3–2.8 cm, rounded or emarginate at the apex, rounded at the base, more or less scaly, obtusely keeled around the margin, with 12–25 distinct vertical ribs on the outer surface, the pericarp thick and woody.

Distribution — *Malesia*: New Guinea (Irian Jaya: ?Vogelkop, ?Jayapura; Papua New Guinea: Madang, Western, Central Provinces), New Britain.

Habitat & Ecology — Lowland rain forest, coast- and flood-plain forests, up to 120 m altitude. Fl. April, Oct.; fr. Aug.

3. *Kingiodendron tenuicarpum* Verdc.

Kingiodendron tenuicarpum Verdc., Kew Bull. 32 (1977) 245; Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 98. — Type: *Streimann & Kairo NGF 39186* (LAE holo; A, BO, BRI, CANB, K, L, SING), Papua New Guinea.

Tree to 18 m high; young shoots glabrous. *Leaves* 4–6-foliate; petiolules 3–5 mm. *Leaflets* elliptic-oblong, 5.5–7.4 by 2.4–3.5 cm, acuminate at the apex, rounded at the base, glabrous; midrib impressed above, prominent beneath; lateral nerves c. 20, close, the tertiary venation reticulate. *Flowers* not seen. *Pods* irregularly ovate, slightly obcordate, 4.2–4.7 by 3.7–4.2 by 1.5–1.9 cm, densely rugulose, glabrous, the pericarp much thinner than that of *K. novoguineense*. *Seeds* slightly smaller than the pod.

Distribution — *Malesia*: Papua New Guinea (West Sepik Prov.).

Habitat & Ecology — In lowland rain forest on limestone ridge, 120 m altitude. Fr. Jan.

KOOMPASSIA

(Ding Hou)

Koompassia Maingay ex Benth. in Hook., Icon. Pl. 12 (1873) 58, t. 1164; de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1947) 309; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 37. — Type species: *Koompassia malaccensis* Maingay ex Benth.
Abauria Becc., Malesia 1 (1877) 169. — Type species: *Abauria excelsa* Becc. [= *Koompassia excelsa* (Becc.) Taub.].

Trees, deciduous. *Stipules* free, very small and caducous. *Leaves* distichous or spiral, imparipinnate. *Leaflets* 5–12(–17) per leaf, alternate, petiolulate; midrib furrowed above, prominent below; lateral nerves usually many, very slender, often obscure and hardly distinguishable especially on the upper surface; veins loosely finely reticulate, often obscure or indistinct. *Inflorescences* axillary or terminal, paniculate; bracts and bracteoles minute, inconspicuous, usually caducous; pedicels very short or absent. *Hypanthium* absent. *Calyx* 5-lobed, lobes regular, imbricate, puberulous to thinly pubescent. *Petals* 5, more or less equal in shape and size. *Disk* absent. *Stamens* 5, free, more or less equal in length; filaments very short, glabrous; anthers basifix, opening with apical and basal pores, both pores connected by a thin (nearly) dehiscent rim and sometimes appearing to be longitudinally dehiscent. *Ovary* sessile or subsessile, 1-ovuled; style and stigma rather short and small. *Pods* laterally strongly compressed, twisted 180° or not at the base, indehiscent or slightly dehiscent only when germinating, surrounded by a broad, papery wing, the centre thickened and veined. *Seeds* strongly laterally compressed, exalbuminous.

Distribution — A small genus of 3 species in *Malesia*: Sumatra, Malay Peninsula, Borneo, Philippines and New Guinea.

Uses — The timber is suitable for structural usage, when treated with wood preservatives also outdoors. See Wan Razali & Sudo in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 270–275.

KEY TO THE SPECIES

- 1a. Flowers large, more than 7.5 mm long, in loose, few-flowered panicles. Petals 8–11 mm long. Anthers hairy on the inner side. Pods not twisted but straight at the base **2. *K. grandiflora***
- b. Flowers small, less than 3.5 mm long, in densely flowered panicles. Petals 2.5–3.25 mm long. Anthers glabrous. Pods twisted 180° at the base **2**
- 2a. Leaflets obtuse or acute and slightly notched at the apex. Petals acute at the apex. Anthers oblong, 2–3 mm long. Ovary compressed oblong or obovate-oblong, glabrous except some hairs at the basal part. Pods glabrous **1. *K. excelsa***
- b. Leaflets acuminate at the apex. Petals rounded at the apex. Anthers heart-shaped, 0.5–0.75 mm long. Ovary compressed globular, densely dark-brown pubescent. Pods pubescent **3. *K. malaccensis***

1. *Koompassia excelsa* (Becc.) Taub.

Koompassia excelsa (Becc.) Taub. in Engl. & Prantl, Nat. Pflanzenfam. 3, 3 (1891) 156; Merr., Philipp. J. Sc., Bot. 10 (1915) 12; Ridley, Fl. Malay Penins. 1 (1922) 620; de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1947) 311; Corner, Wayside Trees, ed. 2, 1 (1952) 397, t. 102; Whitmore in Tree Fl. Malaya 1 (1972) 264; Cockb., Trees Sabah 1 (1976) 172, t. 10, f. 37; Meijer, Field Guide Trees W Mal. (1974) 187, t. 13; K. & S.S. Larsen in Fl. Thailand 4 (1984) 84. — *Abauria excelsa* Becc., Malesia 1 (1877) 169; Taub., Ber. Deutsch. Bot. Ges. 10 (1892) 641, t. 32, f. 1; 1–3; Becc., For. Born. (1902) 172, f. 34. — Type: *Beccari 1818* (Fl holo), Sarawak.

Koompassia parvifolia Prain, J. As. Soc. Beng. 66, ii (1897) 166, 486; Ridley, Agric. Bull. Str. Fed. Mal. St. 1 (1902) 138 ('*parviflora*'). — Type: *Scortechini 1996*, Malay Peninsula.

Giant *tree* up to 75(–88) m high, 1(–2.7) m in diam.; buttresses steep, thick and up to 12 m high; bole straight, smooth and cylindric. *Stipules* oblong, 2–4.5 mm long, pubescent outside. *Leaves* 7–12(–17)-foliolate, rachis slender 6–7.5 cm, pubescent, glabrescent; petiole c. 1.5 cm; petiolules short, 1–2.5 mm, pubescent. *Leaflets* elliptic oblong, sometimes elliptic, symmetrical, 3.1–3.7(–4.2) by 1–1.4(–1.7) cm; base sub-rotundate to cuneate; apex obtuse or acute and slightly notched; glabrous except sparsely hairy above, densely pubescent beneath. *Inflorescences* up to 11(–12.5) cm long, rachis pubescent, densely flowered; pedicels c. 1.5 mm, densely puberulous. *Calyx* lobes lanceolate, equally sized, 2.5–3.25 mm long, thinly puberulous outside. *Petals* oblong or narrow-elliptic, 2.5–3 by 0.5 mm, acute or acuminate at the apex, glabrous. *Stamens* slightly longer than the petals; filaments stout, about as long as the anthers; anthers oblong, 2–3 mm long, glabrous. *Ovary* sessile, oblong or obovate-oblong, compressed, glabrous except some hairs at the basal part; style very short (c. 0.3 mm) and stigma indistinct. *Pods* oblong or elliptic-obovate, 8–12.5 by 2–3.5 cm (including the wing), strongly veined, glabrous. *Seeds* very flat, compressed, oblong, 2–3 by 1 cm.

Distribution — S Thailand (Peninsula); *Malesia*: Sumatra (Eastcoast), Malay Peninsula (not yet found S of Pahang River), Borneo (Sabah, Sarawak), Philippines (Palawan I.).

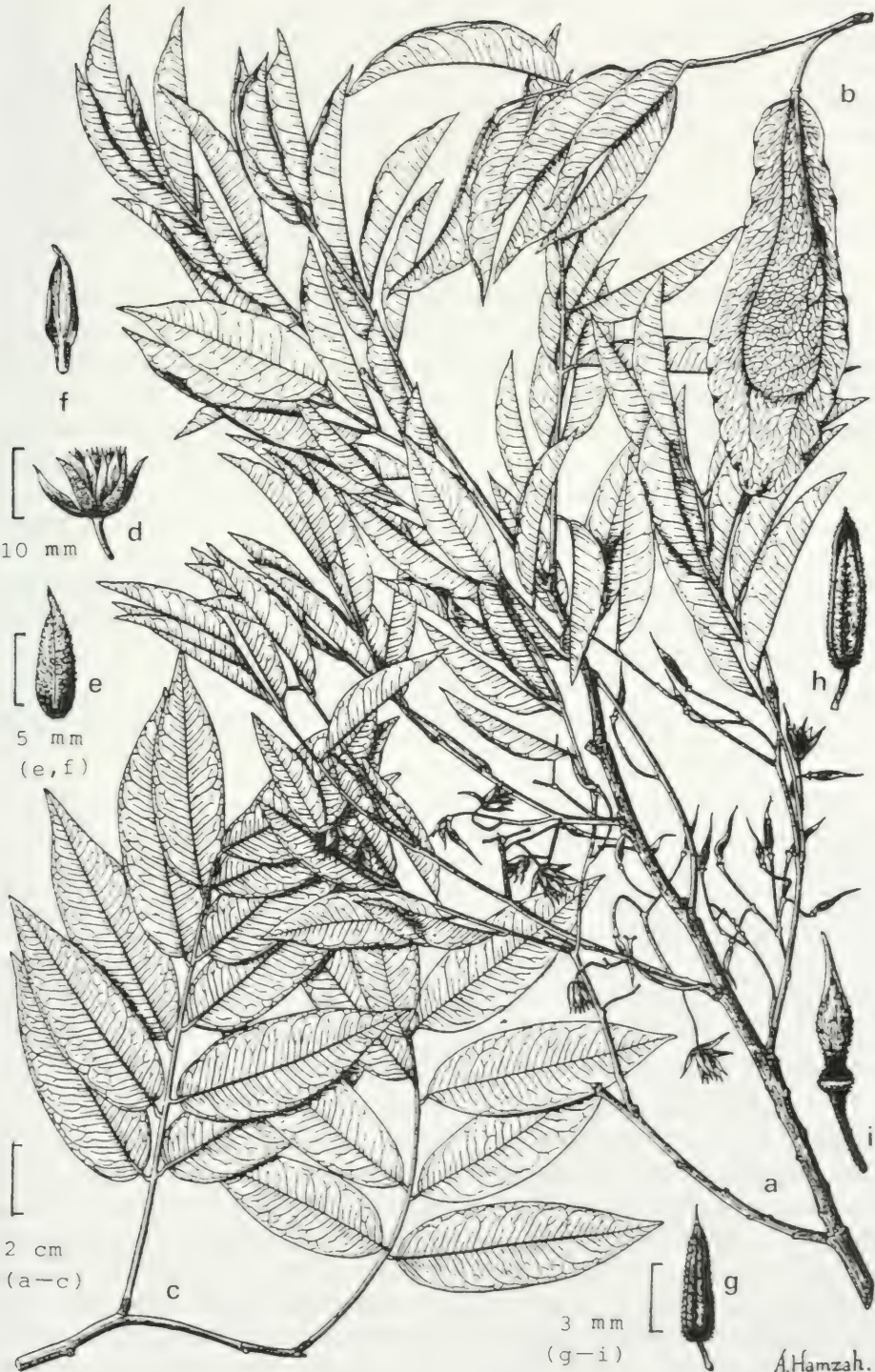
Habitat & Ecology — Primary forests, stream valleys and lower slopes of ridges, up to 400(–600) m altitude. The trees are often remaining in areas of secondary growth because they are rarely felled. Flowering in irregular intervals, on the average once in 5 or 6 (or even 25) years, in April, May, July–Sept., Dec. Fruits are rather rare, found in June–Aug., Oct.

Uses — See under the genus.

2. *Koompassia grandiflora* Kosterm.

Koompassia grandiflora Kosterm., Bull. Bot. Gard. Buitenzorg III, 18 (1950) 443, f. 2; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 57, f. 13. — Type: *Kostermans 492* (= *Neth. Ind. For. Serv. bb 33641*) (BO holo; L), Irian Jaya.

Fig. 38. *Koompassia grandiflora* Kosterm. a. Flowering branch; b. fruiting branch; c. branch with fully grown leaves; d. flower; e. calyx lobe, outside view; f. petal, inside view; g, h. stamens; i. pistil. Reproduced from Bull. Bot. Gard. Buitenzorg III, 18.



Giant *tree* up to 37(–50) m high; bole straight, smooth and cylindric, 1(–1.2) m in diam.; buttresses up to 0.75–5 m high, 3 m wide and 10 cm thick; branchlets glabrous or slightly pubescent. *Stipules* lanceolate, 1–2 mm long, puberulous outside. *Leaves* (3–)7–9(–13)-foliolate; rachis 8–10 cm, slightly and minutely puberulous, glabrescent; petiole 1–4 cm; petiolules short, 2.5–3.5 mm, densely minutely puberulous. *Leaflets* rather thin, chartaceous, elliptic, ovate-lanceolate, more or less symmetrical, (2.5–)4.5–8(–10.5) by (1–)1.5–3.5 cm; base usually rounded; apex acute or acuminate, glabrous, glossy above, loosely minutely pubescent beneath. *Inflorescences* sometimes branched at the base and appearing as 2 together, 3–6(–10) cm long; rachis pubescent, loosely flowered; pedicels 8–10 mm. *Calyx* lobes lanceolate, 7–10 mm long, slightly puberulous outside. *Petals* creamy green or orange-yellow, lanceolate, 8–11 by 2 mm, acute or acuminate at the apex. *Stamens* 7–8 mm long; filaments slender, c. 2.5 mm, glabrous; anthers large, lanceolate, 5–6 mm long, usually hairy on the inner side, sharply and conspicuously apiculate. *Ovary* elliptic-lanceolate, c. 4 mm long, hairy at the basal part and along the margins, the apical part narrowed into the glabrous style (up to 9 mm) and indistinct stigma. *Pods* greenish brown, obovate-oblong, oblong, 9–15 by 2.5–5 cm (including the broad wing), the basal part not twisted, glabrous, veined. *Seeds* brown, very flat, broadly ovate, c. 3.5 by 2.5 cm. — **Fig. 38.**

Distribution — *Malesia*: New Guinea: Irian Jaya (Vogelkop), Papua New Guinea (Morobe, Gulf and Central Provinces).

Habitat & Ecology — Primary rain forest, coastal plain foothills, stony low hill, loam-soil or sandy loamsoil, up to 840 m altitude. Fl. Oct.; fr. July, Sept.

Uses — The timber is used for cabinet making, flooring and general construction work (Verdcourt, l.c.). See under genus.

3. *Koompassia malaccensis* Benth.

Koompassia malaccensis Maingay ex Benth. in Hook., Icon. Pl. III, 2 (1876) 58, t. 1164; Taub., Ber. Deutsch. Bot. Ges. 10 (1892) 641, t. 32, f. II: a–c; Merr., Philipp. J. Sc., Bot. 10 (1915) 12; Ridley, Fl. Malay Penins. 1 (1922) 620; Steenis, Bull. Jard. Bot. Buitenzorg III, 12 (1932) 170; Corner, Wayside Trees 1 (1940) 397, f. 133; de Wit, Bull. Bot. Gard. Buitenzorg III, 17 (1947) 317; Whitmore in Tree Fl. Malaya 1 (1972) 265; Meijer, Field Guide Trees W. Mal. (1974) 189, f. 45; Cockb., Trees Sabah 1 (1976) 174, f. 37; K. & S.S. Larsen in Fl. Thailand 4 (1984) 84; H. Keng, Conc. Fl. Sing. (1990) 36. — Lectotype (de Wit 1947): *Maingay 604* (K holo; L), Malay Peninsula.

Koompassia beccariana Taub., Ber. Deutsch. Bot. Ges. 10 (1892) 641; Merr., Philipp. J. Sc., Bot. 10 (1915) 12. — Type: *Beccari 2690* (B holo, destroyed; BO, FI), Sarawak.

Giant *tree* up to 45(–60) m high and 64(–120) cm in diam.; buttresses steep, plank-like, thick and up to 3(–6) m high. *Stipules* broadly ovate, 2–2.5 mm wide, pubescent outside. *Leaves* 5–9(–14)-foliolate; rachis slender 6.5–19 cm, pubescent, glabrescent; petiole 1.5–4 cm; petiolules short, 4–7.5(–9) mm, densely minutely puberulous. *Leaflets* thinly to rigidly coriaceous, ovate-elliptic, elliptic-oblong or lanceolate, more or less symmetrical, 5.5–10.4(–12.5) by 1.5–5 cm; base usually rounded; apex acuminate; glabrous except minutely puberulous on the midrib above, densely to thinly pubescent beneath. *Inflorescences* up to 12 cm long, rachis pubescent, densely flowered; pedicels

0.75–2.5 mm, densely puberulous. *Calyx* lobes lanceolate, 2.5–3 by c. 1 mm, densely puberulous outside. *Petals* orbicular to obovate, c. 2.5 by 1.1 mm, rounded at the apex, glabrous. *Stamens* nearly half the length of the petals; filaments slender, 0.5–0.75 mm; anthers heart-shaped, about as long as the filaments, glabrous. *Ovary* c. 1 mm long, densely dark brown puberulous; style very short and stigma indistinct. *Pods* oblong, 9.5–15 by 3–4.5 cm incl. the wing, pubescent, veined. *Seeds* very flat, compressed, irregularly oblong, up to 3.3 by 1 cm, purplish black and shallowly rugose.

Distribution — *Malesia*: Sumatra, Riau Archipelago, Bangka, Biliton, throughout Malay Peninsula, Borneo.

Habitat & Ecology — Lowland forests, up to 800 m, often favouring an altitude not exceeding 150 m, also found in peat and fresh water swamps. Fl., fr. throughout the year. For dispersal, see page 411.

Uses — Timber eminently suitable for heavy permanent structures, and also good for flooring, railway sleepers, dock blocks, fence posts, shingles, etc. See under the genus.

LEUCOSTEGANE

(Ding Hou)

Leucostegane Prain, Ann. Bot. Gard. Calc. 9, 1 (1901) 37; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 38. — Type species: *Saraca latistipulata* Prain [= *Leucostegane latistipulata* (Prain) Prain].

Trees. *Stipules* intrapetiolar, persistent. *Leaves* spiral, paripinnate, (1- or) 2–5- (or 6-)jugate; stipels very small. *Leaflets* opposite or subopposite, often with a small, swelling gland on the margin close to the base, petiolulate. *Inflorescences* racemose, fascicled, on trunks or old branches, or in axils of fallen leaves; bracts and bracteoles small, persistent beyond anthesis or deciduous. *Flowers* bisexual, zygomorphic, pedicels articulated above the two bracteoles. *Hypanthium* infundibuliform, tubular, or cylindric. *Calyx* lobes 4, imbricate. *Petals* 2 (or 1) developed, lateral, much shorter or smaller than the calyx lobes, with or without reduced or rudimentary ones. *Stamens* 2 fertile, opposite the petals; filaments filiform, dilated at basal parts; anthers ovoid or oblong, longitudinally dehiscing; staminodes 2 or 3. *Ovary* with the stipe free from or adnate to the floral tube, oblong or elliptic, 2–5- (or more-)ovuled; style filiform; stigma capitate. *Pods* recurvate, oblong, compressed, smooth, shortly beaked, dehiscent, the valves coriaceous or woody, at length twisted, 3–5-seeded. *Seeds* discoid or ellipsoid.

Distribution — *Malesia*: Malay Peninsula and Borneo (Sarawak), 2 species.

Habitat — Lowland forest.

Notes — 1. Some sterile specimens of *Leucostegane* may resemble *Saraca*. However, in the former the leaflets are sometimes stipellate and the stipules are intrapetiolar and persistent while in *Saraca* the leaflets are never stipellate and the stipules are axillary and usually caducous.

2. Flowering collections of *Leucostegane* can be distinguished easily from collections of *Saraca* by the presence of two petals, with or without reduced or rudimentary ones (against petals absent) and two fertile stamens (against usually 4–8).

3. The pollen grains of *Leucostegane* and *Saraca* are globose, tricolporate. However, the exine patterns in these two genera are quite different: conspicuously verrucate in the former and scabrate-punctate in the latter.

KEY TO THE SPECIES

- a. Leaves (1- or) 2- (or 3-)jugate. Stipules small, up to 7 mm long. Calyx lobes obovate or oblanceolate, 12 by 4–6 mm. Pods curved, 26 by 6 cm . . . **1. *L. grandis***
- b. Leaves (1–3-) 5- (or 6-)jugate. Stipules large, often foliaceous, 12.5–40 mm long, rarely associated with some small ones. Calyx lobes oblong or elliptic, 5–6 by 2.5–3 mm. Pods straight, oblong, 5–10 by 2–5 cm **2. *L. latistipulata***

1. *Leucostegane grandis* Ridley

Leucostegane grandis Ridley, Kew Bull. (1929) 257. — Type: *Haviland 1799* (K holo; L), Sarawak.

Tree up to 12 m high and 16 cm in diam. *Stipules* small, ovate, up to 7 mm long, persistent. *Leaves* (1- or) 2- (or 3-)jugate, glabrous; petiole and rachis 3.5–8.5 cm. *Leaflets* coriaceous, elliptic, oblong, 8.5–18(–27.5) by 2.5–8.5(–9.5) cm; apex acuminate; base obtuse, sometimes slightly unequal; nerves 7–12 per side, inconspicuous, sometimes visible beneath; veins often obscure or invisible; petiolules c. 6 mm; stipels very small, sometimes wanting on some of the leaflets. *Inflorescences* 3.5–5(–8) cm long; bracts and bracteoles ovate or triangular, c. 2.5 mm long, sparsely hairy outside, ciliate on the margin; pedicels up to c. 2 cm. *Flowers* white tinged with red or purple. *Calyx* lobes obovate or oblanceolate, 10–12 by 4–5 mm, almost glabrous except sometimes ciliate on the margin. *Petals* small, ovate or elliptic, 7–9 by 2–4.5 mm, shortly clawed at base. *Stamens*: filaments c. 12 mm, dilated at base; anthers c. 3 mm long. *Ovary* oblong, c. 5 mm long, pubescent; stipe c. 2 mm; style c. 10 mm. *Pods* hatchet-shaped, 26 by 5 cm. *Seeds* (young) elliptic, 15 by 8 mm. — **Fig. 39a.**

Distribution — *Malesia*: Sumatra (Bukit Sebelah Nat. Res.), Borneo (Sarawak).

Habitat & Ecology — Lowland forest up to 850 m altitude, also found on limestone and in swamp forest. Fl. Jan., April, July, Sept.; fr. April, May.

Note — The number of calyx lobes in the present species is 4, not 5 as stated in the original description.

2. *Leucostegane latistipulata* (Prain) Prain

Leucostegane latistipulata (Prain) Prain, Ann. Bot. Gard. Calc. 9, 1 (1901) 38, t. 46; Ridley, Fl. Malay Penins. 1 (1922) 643; Whitmore in Tree Fl. Malaya 1 (1972) 266. — *Saraca latistipulata* Prain, J. As. Soc. Beng. 66, ii (1897) 217, 493. — Syntypes: *Ridley 3089* (K holo; L photo), *8006*, both Perak.

Small *tree* up to 6 m high and c. 4 cm in diam. *Stipules* large, often foliaceous, ovate or lanceolate, 12.5–40 by 7.5–20.5 mm, usually slightly unequal, rarely associated with some very small ones. *Leaves* (1–3-) 5- (or 6-)jugate; rachis and petiole 14–22.5 cm,



Fig. 39. *Leucostegane grandis* Ridley. a. Flowering branch with small connate stipules and very young fasciculate inflorescences. — *Leucostegane latistipulata* (Prain) Prain. b. Basal part of leaf with foliaceous stipules only basally connate; c. inner view of one valve of pod (a: Daud & Tachun SF 35632; b, c: Whitmore FRI 0984). Drawing Ding Hou.

puberulous. *Leaflets* rigidly coriaceous, ovate-lanceolate, 10.5–23 by 4–5.5 cm; apex acuminate or caudate; base somewhat obliquely obtuse; glabrous above, pubescent on the midrib beneath and puberulous along the margins; nerves 8–10 per side; veins ob-

scure or invisible on both surfaces; petiolules c. 4 mm; stipels very small or wanting. *Inflorescences* c. 2 cm long; bracteoles and pedicels puberulous. *Flowers* white or flushed violet. *Hypanthium* 3–4 mm long, puberulous outside. *Calyx* lobes oblong or elliptic, 5–6 by 2.5 mm, sparsely puberulous outside. *Petals* small, ovate, 2.5–3 by 1.5–2 mm, membranous and strongly veined, with a very short claw; 1 posterior, minute, rudimentary petal. *Stamens*: filaments twice as long as calyx lobes in fully opened flowers, united at the basal c. 1 mm. *Ovary* puberulous along the margin, glabrescent or glabrous in the centre. *Pods* straight, oblong, 9.5–10 by c. 5 cm, shortly beaked. *Seeds* round, flat, c. 1.5 cm diam., the margin irregularly curved, finally rugose on one side, rather smooth on the other. — **Fig. 39b, c.**

Distribution — *Malesia*: Malay Peninsula (Perak, also Rembia Islands).

Habitat & Ecology — Lowland hill forest. Fl. Sept.; fr. Feb., Dec.

MANILTOA

(Ding Hou)

Maniltoa Scheff., Ann. Jard. Bot. Buitenzorg 1 (1876) 20; Meeuwen, Blumea 18 (1970) 31; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 57; Cowan & Polhill in Polhill & Raven, Adv. Leg. Syst. 1 (1981) 124; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 40. — Type species: *Maniltoa grandiflora* (A. Gray) Scheff.

Schizosiphon K. Schum. in K. Schum. & Hollr., Fl. Kais. Wilh. Land (1889) 101, non Kütz. 1843 (Cyanobacteria). — *Schizoscyphus* K. Schum. ex Taub., Bot. Centralbl. 41 (1890) 265, nom. nov. for *Schizosiphon* K. Schum. — Type species: *Schizosiphon roseus* K. Schum. [= *Maniltoa rosea* (K. Schum.) Meeuwen].

Pseudocynometra Kuntze in T. Post & Kuntze, Lexic. (1903) 464. — Type species: *Cynometra polyandra* Roxb. [= *Maniltoa polyandra* (Roxb.) Harms].

Trees; growth flush-wise, the flushes developing from large buds. *Buds* covered by 2-ranked, brown, caducous bud scales with lengthwise veins; new leaves developing in bright white or pink tassels. *Stipules* present in the buds, very tender, caducous immediately after the unfolding of the bud, leaving hardly any scar. *Leaves* simply pinnate, (1- or) 2–15-jugate. *Leaflets* opposite, asymmetric and the midrib usually excentric and close to the upper margin; mostly glabrous. *Inflorescences* axillary, racemose, sessile, globular, contracted, dense, the rachis usually sturdy; bracts scale-like, veined lengthwise, lower ones broad reniform, gradually becoming ovate to lanceolate from halfway through the raceme, mostly persistent, appressed-hairy, glabrescent or not; bracteoles caducous, either linear, flat, small (not exceeding 5 mm), or larger (5–20 mm), obovate to spatulate, folded lengthwise with an apical tuft of hairs and usually a line of hairs along the dorsal side. *Flowers* bisexual. *Hypanthium* cupular and splitting under the developing fruit, or funnel-shaped (rarely tubular) enveloping the ovary and then splitting lengthwise as the fruit ripens. *Sepals* 4 (or 5), imbricate, reflexed at anthesis. *Petals* 5 (very occasionally some or all of them absent in *M. brassii*), narrow, free, glabrous. *Disk* absent. *Stamens* 15–80, filaments often connate at base, sometimes with a few hairs; anthers medi-dorsifix, lengthwise introrsely dehiscent, 1–2 mm long, very often separate below the insertion of the filament, mostly apiculate at apex. *Ovary* 1- (or 2-)

ovuled, sessile or stipitate, the stipe usually central. *Pods* woody, ovoid, globose, sometimes oblong, or somewhat kidney-shaped, often compressed, indehiscent. *Seeds* globular, cotyledons smooth, semi-globular.

Distribution — A genus of 20–25 species, distributed in India, SE Asia, Malesia, Melanesia, Australia, and the Pacific Islands (Carolines, Solomon Islands, Fiji, and Tonga). About 13 species occurring in *Malesia* (most of them in New Guinea, some also in Celebes and Moluccas), not including the species only found in the Solomon Islands.

Habitat — Primary forests at low altitudes, up to 500(–1300) m, often in swampy areas, occasionally in the mangrove (*M. brassii*).

Uses — Plants of this genus are used as ornamentals because of their beautifully coloured young leaves and flowers.

Note — The genus *Maniltoa* is very closely allied to *Cynometra* and was treated as a section of the latter genus by Taubert [in Engl. & Prantl, Nat. Pflanzenfam. 3, 3 (1892) 129]. Some years later, however, Harms [in Engl. & Prantl, Nat. Pflanzenfam. 3, 3 (1897) 193] maintained it as a distinct genus, and since that treatment, *Maniltoa* has been generally accepted. Because the two genera had never been revised as a whole and there had been confusion concerning their generic limits, Knaap-van Meeuwen (1970) made a thorough study of the genera, reviewing the history of their classification. She redelimited the two genera and listed the main differences especially in floral characters in the keys to the genera in her revision. Since then her delimitation of the two genera has generally been followed by, for example, Verdcourt (1979), Cowan & Polhill (1981), A.C. Smith [Fl. Vit. Nova (1985) 122–132], and also in the present Flora.

KEY TO THE SPECIES

1a. Leaflets cuneate, very rarely obtuse at the base	2
b. Leaflets rounded or auriculate at the base	6
2a. Leaflets sessile	3
b. Leaflets petiolulate, petiolules 2–10 mm	4
3a. Leaflets obovate; midrib very excentric, 2–4 mm from the upper margin	
	3. <i>M. cynometroides</i>
b. Leaflets ovate-oblong or oblong, midrib not so excentric as above, more than 6 mm from the upper margin	9. <i>M. polyandra</i>
4a. Leaflets obtuse and emarginate at the apex	10. <i>M. psilogyne</i>
b. Leaflets acuminate at the apex	5
5a. Leaflets with the acumen well-developed, bifid at the tip for 1–3 mm and the lobes often pincers-like	5. <i>M. lenticellata</i>
b. Leaflets with the acumen slightly emarginate at the tip, only rarely bifid	
	12. <i>M. schefferi</i>
6a. Leaflets petiolulate, the petiolule 2–2.8 mm	7
b. Leaflets sessile (more or less sessile in <i>M. fortuna-tironis</i>)	8

- 7a. Leaflets with the apex acuminate. Hypanthium cupular, 3.5–5 mm deep, pubescent on both surfaces **6. *M. mariettae***
- b. Leaflets with the apex obtuse or emarginate. Hypanthium glabrous **7. *M. megalocephala***
- 8a. Leaflets with the midrib often (very) excentric, 1–6 mm from the upper margin 9
- b. Leaflets with the midrib not excentric as above, 7.5–27 mm from the upper margin 11
- 9a. Leaves 4–15-jugate 10
- b. Leaves (1-) 2- or 3-jugate 12
- 10a. Hypanthium funnel-shaped, 9–10 mm deep. Ovary sessile **11. *M. rosea***
- b. Hypanthium cupular, 2–2.5 mm deep. Ovary stipitate, the stipe c. 7 mm **8. *M. plurijuga***
- 11a. Hypanthium funnel-shaped, 5–6 mm deep. Ovary sessile **1. *M. brassii***
- b. Hypanthium short-cupular, 1.5–2.5 mm deep. Ovary stipitate, the stipe 3–4 mm **2. *M. browneoides***
- 12a. Hypanthium tube-like, 5–6 mm deep. Ovary sessile .. **4. *M. fortuna-tironis***
- b. Hypanthium short-cupular, 1–1.5 mm deep. Ovary stipitate, the stipe 2–4 mm .. **13. *M. steenisii***

1. *Maniltoa brassii* Merr. & L.M. Perry

Maniltoa brassii Merr. & L.M. Perry, J. Arnold Arbor. 23 (1942) 398; Meeuwen, Blumea 18 (1970) 35, f. 4c, d; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 61. — Type: *Brass* 1428 (A holotype; K), Papua New Guinea.

Shrub or *tree* mostly 5–7.5(–10) m high. *Leaves* 2–5-jugate; rachis 3–21 cm and petiole 0.5–1.5 cm, both pubescent, usually glabrescent. *Leaflets* variable in shape, size, and texture, ovate-oblong to obliquely lanceolate, 7–23 by 3–6 cm, glabrous, sessile; apex acuminate or obtuse, the actual tip usually emarginate; base asymmetrically rounded, scarcely auriculate; midrib 0.8–1.5 cm from the upper margin. *Inflorescences* dense, up to 6 cm wide, the rachis 2.5–6 cm; bracts greenish brown, 2.5–3 cm long, pubescent; bracteoles 9–15 mm long; pedicels (2–)3–5(–10) mm, hairy. *Hypanthium* (1.5–)5–6 mm deep, enclosing the ovary, inside sometimes lined with hairs. *Sepals* 4, unequal, 1–1.6 cm long. *Petals* creamy brown, 1.6–2 cm long, even in young buds not always all present. *Stamens* 32–43; filaments 15–24 mm, connate at the base for 0.25–2 mm; anthers apiculate. *Ovary* densely pubescent, sessile, partially to entirely enclosed by the hypanthium; style 1.4–2.5 cm. *Fruits* 2–2.5 by 1.5–1.8 by c. 1 cm. — **Fig. 40c, d.**

Distribution — *Malesia*: Papua New Guinea (Morobe, Central and Milne Bay Provinces, and Papuan Islands?).

Habitat & Ecology — Mangrove swamp or swamp forest, up to 100 m altitude. Fl. Feb., March, July, Nov., Dec.; fr. July, Nov.

2. *Maniltoa browneoides* Harms

Maniltoa browneoides Harms, Notizbl. Berl.-Dahl. 3 (1902) 190; Meeuwen, Blumea 18 (1970) 41, f. 6; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 62. — *Pseudocynometra browneoides*

(Harms) Kuntze, Deutsch. Bot. Monatsschr. 21 (1903) 173. — Type: *Forbes 1204a* (B holo, lost; BM), collected from a tree, native of New Guinea, cultivated in Bot. Gard. Bogor (no. I-I-33).

Maniltoa gemmipara Scheff. ex Backer, Voorl. Schoolfl. Java (1908) 103; Schoolfl. Java (1911) 423; Funke, Ann. Jard. Bot. Buitenzorg 40 (1929) t. 11, 13, f. 5. — Type: *Backer s.n.* (L), from a plant cultivated in Java (Jakarta, Weltevreden).

Maniltoa grandiflora auct. non (A. Gray) Scheff.: Backer & Bakh. f., Fl. Java 1 (1964) 536.

Tree 9–30 m high and 12–40 cm in diam.; buttresses 1 m high, 1 m wide and 3 cm thick. *Leaves* (2- or) 3- or 4-jugate; rachis 5.5–21 cm, puberulous, glabrescent; petiole 1–2 cm, rugose. *Stipules* only found together with the limp young leaves, 1.7–2.2 cm long, caducous, leaving no scars. *Leaflets* sessile, ovate, elliptic, ovate-oblong, or oblong, 4.5–20 by 3–8 cm; apex mostly more or less acuminate, tip usually obtuse and emarginate; base conspicuously auriculate on the basiscopic side. Rachis of the *inflorescence* 14–25 mm, puberulous or pubescent, glabrescent; bracts 4–6 cm, sericeous, glabrescent; bracteoles 1.3–1.9 cm long, at c. 3 mm above the base of pedicel; pedicels 1.6–3.4 mm, puberulous, glabrescent. *Hypanthium* 1.5–2.5 mm deep. *Sepals* 13–18 mm, sometimes with a few hairs near the tip. *Petals* 11–19 mm long. *Stamens* 60–80; filaments 17–29 mm, connate over 2–4 mm at the base; anthers apiculate. *Ovary* 1.5–3 cm long, slightly to distinctly hairy; stipe 3–4 mm; style 15–17 mm. *Fruits* 2.2–2.5 by 1.2–1.3 by 1.1 cm, breaking off above the stipe.

Distribution — *Malesia*: New Guinea: Irian Jaya (Jayapura, Digul), Papua New Guinea (Central and Northern Provinces).

Habitat & Ecology — Rather common, in rain forest, usually in swampy places, secondary forest, 0–75 m altitude, once at 400 m altitude. Fl. March. Sept.–Nov.; fr. April, Sept.

Uses — Cultivated specimens seen from Java, Kangean I., and N Sumatra.

3. *Maniltoa cynometroides* Merr. & L.M. Perry

Maniltoa cynometroides Merr. & L.M. Perry, J. Arnold Arbor. 23 (1942) 397; Meeuwen, Blumea 18 (1970) 39; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 62. — Type: *Brass 6903* (A holo; BM, BO, BRI, L), Papua New Guinea.

Tree 9–30 m high, 10–45(–140?) cm in diam.; small low buttresses sometimes present, to c. 1 m high. *Leaves* 2-jugate, the upper pairs larger than the lower ones; rachis 1.2–2 cm and petiole 0.5–1 cm, both more or less pubescent. *Leaflets* obovate-cuneate, 2–5 by 0.8–4 cm, obtuse and emarginate at the apex, cuneate at the base, sessile, the midrib very excentric, 2–4(–5) mm from the upper margin. *Inflorescences* apparently terminal or in the axils of the upper leaves, the rachis 0.4–1.1 cm, dense puberulous, glabrescent; bracts up to 1 cm long; bracteoles 5–6 mm long; pedicels 7–9 mm, pubescent. *Hypanthium* cupular. *Sepals* 5 mm long. *Petals* not seen. *Stamens* 20–25, the filaments 3 mm, connate at the extreme base. *Ovary* not enclosed in hypanthium, hairy. *Fruits* ovoid, compressed, 1.5–5 by 1.2–2 by 0.5–2 cm, not stipitate, more or less hairy.

Distribution — Fiji (Matuku); *Malesia*: Moluccas (Morotai, Kai Is.), New Guinea (Irian Jaya: Vogelkop, Jayapura, Mimika, Digul; Papua New Guinea: W & E Sepik, Madang, Morobe, Western Provinces).

Habitat & Ecology — Swamp forest, primary forests on sandy soil, secondary forest, up to 100(–530) m altitude. Fl. July, Aug.; fr. May–Aug.

4. *Maniltoa fortuna-tironis* Verdc.

Maniltoa fortuna-tironis Verdc., Kew Bull. 32 (1977) 243, f. 3; Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 63, f. 14. — Type: *Verdcourt, Huxley & Dodd 4899* (K holo; L, LAE, UPNG), Papua New Guinea.

Tree 7.5–10 m high, bark thin, smooth, slightly pustular. *Leaves* 2- or 3-jugate, rachis 1–4.5 cm; petiole 0.3–1.5 cm, glabrous or pubescent. *Leaflets* more or less sessile, obliquely elliptic to elliptic-lanceolate, 2.3–7.2 by 0.8–2.4 cm, obtusely acuminate at the apex, oblique and more or less auriculate at the base, glabrous or minutely puberulous; midrib very excentric, 1.8–5 mm from the upper margin. *Flowers* in subglobose heads up to 3.5 cm long, 4.5 cm wide; buds and bracts pale rose, the latter elliptic-lanceolate, up to 2.3 by 1 cm, rusty hairy outside. *Hypanthium* 5–6 mm deep, glabrous. *Sepals* 3, 8–9 mm long. *Petals* white, 9 by 1.5 mm. *Stamens* 16–20; filaments white, 1.5–2.5 cm. *Ovary* completely included in the hypanthium, sessile, glabrous. *Fruits* ovoid, 2.6 by 1.3 cm, shortly acuminate at the apex; stipe absent.

Distribution — *Malesia*: Papua New Guinea (Gulf and Central Provinces).

Habitat & Ecology — Alluvial forest margins, streamside forest, 60–300 m altitude. Fl. Jan., March.

5. *Maniltoa lenticellata* C.T. White

Maniltoa lenticellata C.T. White, J. Arnold Arbor. 8 (1927) 130; Meeuwen, Blumea 18 (1970) 44; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 65. — Type: *Lane Poole 203* (A holo; BRI), Papua New Guinea.

Tree 7.5–42 m high, 12.5–60 cm in diam., sometimes with buttresses, up to 3 m high. *Leaves* (2–)3–7-jugate; rachis 10–18 cm, petiole 0.5–2 cm, petiolules 0.3–0.7 cm. *Leaflets* ovate or obovate, elliptic, or oblong, 5.5–13(–14.5) by 3–5.6(–6.5) cm; apex acuminate, the acumen well-developed, bifid at the tip for 1–3 mm; base asymmetrically cuneate; midrib 8–12(–20) mm from the upper margin; venation above faintly impressed, nerves beneath finely prominent. Rachis of the *inflorescence* 3–6 cm, glabrescent; bracts 1.5–5 cm, appressed-hairy; bracteoles 5–8 mm; pedicels 1.4–3 cm. *Flowers* white-cream. *Hypanthium* 2.5–4 mm deep. *Sepals* 1.3–1.5 cm. *Petals* 1.2–1.8 cm. *Stamens* connate over 0.2–1 mm at the base; filaments 1.4–2.3 cm; anthers apiculate. *Ovary* glabrous to densely hairy; stipe (3–)5–10 mm. *Fruits* 2.5–4.8 by 1.8–3.6 by 0.7–1.7 cm. *Seeds* subreniform, 1.5 by 1 cm.

a. var. *lenticellata*

Ovary glabrous or only slightly pubescent.

Distribution — Australia (Queensland) and *Malesia*: Papua New Guinea (Madang, Morobe, Gulf, Central and Milne Bay Provinces).

Habitat & Ecology — Open high rain forest, forest edges, up to 1050 m altitude. Fl. March, July–Sept., Nov.; fr. March, Dec.

b. var. villosa Verdc.

Maniltoa lenticellata C.T. White var. *villosa* Verdc., Kew Bull. 32 (1977) 241; Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 66. — Type: *Womersley & Vandenberg NGF 37192* (LAE holo; K, L), Papua New Guinea.

Ovary white, enlarging rapidly and turning orange-brown, with dense persistent hairs.

Distribution — *Malesia*: Papua New Guinea (Morobe Prov.), only known from the type.

Habitat & Ecology — Rain forest, 1050 m altitude. Fl. Sept.

Note — Foliage buds are white, the bracts up to 7 by 6 cm, young leaves bright pink, mature foliage glossy green. Petals, stamens and staminodes white.

6. *Maniltoa mariettae* Meeuwen

Maniltoa mariettae Meeuwen, Blumea 18 (1970) 37; Verdc., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 66. — Type: *White, Dadswell & Smith NGF 1661* (BRI holo), Papua New Guinea.

Tree to 9 m high, 12.5 cm in diam. *Leaves* 2- or 3-jugate, the rachis 3–11 cm, glabrous; petiole 6–12 mm. *Leaflets* elliptic to oblong-elliptic, ovate, ovate-oblong, 4–13 by 1.7–6.5 cm; apex acuminate, the acumen emarginate; base oblique, one side adnate to the short petiolule (c. 2 mm), auriculate; very obscurely hairy beneath (hardly visible in adult leaflets); midrib 0.5–1.5 cm from the upper margin. Rachis of the *inflorescence* 2–2.5 cm, hairy; bracts 2 cm long, covered with adpressed hairs; bracteoles c. 1 cm long; pedicels 0.8–1.2 cm, densely pilose. *Hypanthium* 3.5–5 mm deep, pubescent outside and inside. *Sepals* 8 mm long, densely hairy. *Petals* white, 6–10 mm long. *Stamens* with white filaments 8–15 mm, connate at the base for 2–2.5 mm; anthers apiculate. *Ovary* sessile, completely enclosed in the hypanthium, pilose; style 12–15 mm, with a few hairs. *Fruits* rounded reniform in outline, 1.9–2.7 by 1.5–1.8 by 0.8–1 cm, rugose, subglabrous. *Seeds* similar in shape, 2.5 by 1.5 by 0.85 cm, rugose. — **Fig. 40b.**

Distribution — *Malesia*: Papua New Guinea (Morobe Prov.).

Habitat — Near creeks or streams, on rain forest margin, at very low altitudes (15–60 m).

7. *Maniltoa megalocéphala* Harms

Maniltoa megalocéphala Harms, Bot. Jahrb. 55 (1917) 52, f. 2; Verdc., Kew Bull. 32 (1977) 237; Verdc., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 67, f. 15. — Syntypes: *Ledermann 7857, 7895, 10616* (B holo, lost; no duplicates found), Papua New Guinea (Sepik region).

Shrub or *tree* (2–)4.5–12 m high, with brown or greenish brown bark. *Leaves* (2- or 3- or 4-jugate; rachis to 9 cm, glabrous; petiole 8 mm. *Leaflets* elliptic to oblong-elliptic, 5.5–16(–23) by 3.5–9 cm; apex obtuse or asymmetrically emarginate; base very asymmetric, auriculate on one side, adnate to the petiolule (2.8 mm) and slightly hairy; gla-

brous except for a few hairs on the midrib above and below; midrib 1.3–2.7 cm from the upper margin. *Inflorescences* 5–8 cm long, 9 cm wide, the rachis 4.5–8 cm; bracts ovate-lanceolate, 3.5–5.5 by 1.2–2.5 cm, rusty silky; pedicels 0.9–2 cm. *Hypanthium* c. 6 mm deep, glabrous. *Sepals* 3 or 4, 1.8–2.5 by 0.6–1.2 cm. *Petals* white, linear-lanceolate, unequal, 1–2.5 by 0.3 cm. *Stamens* c. 40; filaments 2 cm, united at the base for c. 1.5 mm. *Ovary* 7 mm long, with a few hairs on the curved margin, sessile, almost totally immersed within the hypanthium. *Fruits* oblong, slightly reniform, 3.8 by 2.5 by 1.4 cm.

Distribution — *Malesia*: Papua New Guinea (E Sepik and Madang Provinces).

Habitat & Ecology — Rain forest by rivers and on hills, 30–45 m altitude. Fl. May; fr. May, Aug., Sept.

8. *Maniltoa plurijuga* Merr. & L.M. Perry

Maniltoa plurijuga Merr. & L.M. Perry, J. Arnold Arbor. 23 (1942) 398; Meeuwen, Blumea 18 (1970) 40; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 67. — Type: *Brass* & *Versteegh* 13539 (A holo; BO, BRI, L), Irian Jaya.

Tree (7–)25–40 m high, 37–45(–90) cm in diam.; usually with buttresses 0.3–3.2 m high, 40 cm wide and 4 cm thick, sometimes fissured or fluted. *Leaves* (7–)10–15-jugate; rachis 8.5–23 cm and petiole 0.5–1.1 cm, both rusty hairy. *Leaflets* sessile, oblong to lanceolate, 2.5–6 by 0.6–2 cm; apex obtuse but obliquely emarginate; base rounded or auriculate on the lower side; midrib very excentric, at 1–2.5 mm from the upper margin; usually glabrous, sometimes along the midrib sparsely hairy, nerves invisible on both surfaces. *Inflorescences* to 4.5(–8) cm long, 3.5(–8) cm wide; rachis 3–4.5 cm, densely hairy; bracts 0.4–4 cm long, densely rusty brown velvety hairy; bracteoles 7 mm; pedicels 1.5–3 cm, rather densely hairy. *Flowers* said to turn purple-brown very soon. *Hypanthium* 2–2.5 mm deep. *Sepals* 13–18 mm long, sparsely hairy. *Petals* 9–13 mm long. *Stamens* 30–32; filaments 13–18 mm, free or slightly connate for 0.75 mm at the base; anthers apiculate. *Ovary* densely hairy, the stipe c. 7 mm; style 5–7 mm; *Fruits* 2.7–4.3 by 1.4–1.5 by 1.5 cm, very sparsely hairy.

Distribution — *Malesia*: New Guinea (Irian Jaya: scattered; Papua New Guinea: W Sepik and Morobe Provinces).

Habitat & Ecology — Primary forests, sometimes at riversides, on ridges, both on alluvial clay and limestone, up to 650 m altitude. Fl. April, June; fr. Jan., Feb.

9. *Maniltoa polyandra* (Roxb.) Harms

Maniltoa polyandra (Roxb.) Harms in Engl. & Prantl., Nat. Pflanzenfam., Nachtr. 1 (1897) 194; Bot. Jahrb. 55 (1917) 48; Meeuwen, Blumea 18 (1970) 43. — *Cynometra polyandra* Roxb., Pl. Corom. 3 (1820) 84, t. 286; Baker in Hook. f., Fl. Brit. India 2 (1878) 268; Ridley, Fl. Malay Penins. 1 (1922) 636. — Type: Roxburgh plate 2241 (K); Pl. Corom. t. 286; cf. Sealy, Kew Bull. (1956) 329.

Lofty tree. *Leaves* 2- or 3-jugate; rachis 5 cm and petiole 0.5 cm, both puberulous. *Leaflets* ovate-oblong or oblong, 3.5–6 by 1.5–2.5 cm, apex emarginate; midrib 7–15

(–20) mm from the upper margin, hairy below, glabrescent. Rachis of the *inflorescence* 7–10 mm, tomentose; bracts 2–6 mm long, puberulous, glabrescent; bracteoles 4.5–6 mm, inserted at 1–5 mm above the base of the pedicels; pedicels 11–25 mm, tomentose. *Hypanthium* 1 mm deep. *Sepals* 5.5–7 mm, glabrous or tomentose near the apex. *Petals* 6–8 mm. *Stamens* c. 50, shortly connate at base over 0.25 mm, villous or glabrous (even in one flower); filaments 10–13 mm; anthers apiculate. *Ovary* woolly-villous; stipe 1 mm, obliquely inserted off the centre of the hypanthium and adnate to it; style 5–7 mm. *Fruits* 5.5–6 by 3.5–4 by 1–1.5 cm, glabrous, rough, smooth.

Note — Soerianegara et al. [in Soerianegara & Lemmens (eds.), *Plant Res. SE Asia* (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 153] expressed the opinion that this species occupies an intermediate position between *Maniltoa* and *Cynometra* and, therefore, doubt the distinctness of the two genera. In the characters by which the two genera are distinguished, the present species is, however, not at all intermediate but does clearly belong to *Maniltoa*.

a. var. *polyandra*

Fruits 5.6–6 by 3.5–4 by 1–1.5 cm, glabrous, smooth.

Distribution — India, Burma, Thailand, Cambodia; *Malesia*: Penang I.

Habitat — In forests at 1300 m altitude.

b. var. *kurzii* (Prain) Meeuwen

Maniltoa polyandra (Roxb.) Harms var. *kurzii* (Prain) Meeuwen, *Blumea* 18 (1970) 44; Whitmore in *Tree Fl. Malaya* 1 (1972) 267. — *Cynometra polyandra* Roxb. var. *kurzii* Prain, *J. As. Soc. Beng.* 66, ii (1897) 200, 479. — Type (Knaap-van Meeuwen 1970): *Kurz s.n.* (CAL lectoholo), Penang Island.

Leaves as in the typical variety. Pod very rugose even in mature state, 6 by 3–4.5 cm, flat, with a pronounced beak.

Distribution — Burma; *Malesia*: Malay Peninsula (Penang I.).

Notes — 1. For the specimens of var. *kurzii*, Prain (l.c.) distinctly cited Kurz's collection under Penang and stated that the only fruiting specimen of this variety "has been obtained ... by Kurz alone." Knaap-van Meeuwen (l.c.) chose the type and cited it as "Kurz s.n., loc. Govt. [as Gort.] Hill. Apl. 1890 (lectotype in CAL, no isotypes seen)" and also cited it under the distribution as from Burma. Kurz died in Penang in 1878 [cf. *Fl. Males. I*, 1 (1950) 305a]. The data on the locality and date as quoted above belong to a collection made by Curtis.

10. *Maniltoa psilogyne* Harms

Maniltoa psilogyne Harms, *Bot. Jahrb.* 55 (1917) 50; Meeuwen, *Blumea* 18 (1970) 43; Verdc., *Manual New Guinea Leg.*, *Lae Bot. Bull.* 11 (1979) 69. — Type: *Schlechter 16934* (B holo, lost; A, E, G, K, L, S, Z), Papua New Guinea.

Maniltoa hunsteiniana Harms, *Bot. Jahrb.* 55 (1917) 51. — Type: *Ledermann 8193* (B holo, lost; BM, K), Papua New Guinea.



Fig. 40. *Maniltoa rosea* (K. Schum.) Meeuwen. a. Flowering branch. — *Maniltoa mariettae* Meeuwen. b. Half flower. — *Maniltoa brassii* Merr. & L.M. Perry. c. Young pod; d. flowering rachis. Drawing R. van Crevel. Reproduced from *Blumea* 18.

Tree up to 32 m high and 47 cm in diam., rarely buttressed to 1.2 m high, 80 cm wide, 3 cm thick. *Leaves* 3-jugate; rachis 3–8 cm and petiole 0.5–1.7 cm, both puberulous or glabrous; petiolules 2–3 mm, puberulous, sometimes glabrous. *Leaflets* asymmetrically rhomboid, ovate, or elliptic, 3–10(–15.5) by 1–4.5(–7.2) cm; apex obtuse, emarginate, not or scarcely acuminate; base obliquely cuneate or obtuse; the lower rhomboid pair always with 2–4 lateral nerves in the broad basal half running parallel with the upper margin, reaching from the base up to near the apex; midrib 2–8(–14) mm from the upper margin; petiolules 2–3 mm. *Inflorescences* 3–7 cm long, 5–8 cm wide; rachis 1–3.5 cm, appressed hairy, glabrescent; bracts 1–2 cm, appressed hairy or glabrous; bracteoles 5.5–8 mm; pedicels 8–20 mm, densely hairy or glabrous. *Flowers* white. *Hypanthium* 1–2 mm deep. *Sepals* 7–10 mm long, usually glabrous. *Petals* oblanceolate, 6–12 mm long. *Stamens* c. 20; very shortly connate at base; filaments 7–12 mm, very shortly connate at base. *Ovary* usually with hairs on the swollen side, sometimes glabrous; stipe 1.5–3 mm; style 5–9 mm, rose-pink at the base. *Fruits* compressed ovoid, 2.5–1.3 cm, glossy, brownish green, often rugose when young.

Distribution — *Malesia*: New Guinea, fairly common.

Habitat & Ecology — Forests, up to 400 m altitude. Fl. Feb., March, Aug.–Dec.; fr. Feb., March, Aug.

11. *Maniltoa rosea* (K. Schum.) Meeuwen

Maniltoa rosea (K. Schum.) Meeuwen, *Blumea* 18 (1970) 35, f. 4a, b; Verdc., *Manual New Guinea Leg.*, Lae Bot. Bull. 11 (1979) 70. — *Schizosiphon roseus* K. Schum. in K. Schum. & Holtr., *Fl. Kais. Wilh. Land* (1889) 101. — *Schizoscyphus roseus* (K. Schum.) Warb., *Bot. Jahrb.* 13 (1891) 331; K. Schum. & Lauterb., *Fl. Deutsch. Schutzgeb. Südsee* (1900) 347. — Type: *Holtrung* 492 (B holo, lost, iso not found in WRSL or LE); neotype (Knaap-van Meeuwen 1970); *K.J. White NGF 10226* (K, BRI), Papua New Guinea.

Maniltoa urophylla Harms, *Bot. Jahrb.* 55 (1917) 51, pro folia, excl. infl. — Type: *Ledermann* 8848 (B holo, lost; iso not found in WRSL or LE), Papua New Guinea.

Tree 6–9 m high, 7.5 cm in diam. *Leaves* 4–11-jugate; rachis 3.5–17(–30) cm and petiole 0.5–1.1 cm, both pubescent. *Leaflets* sessile, ovate-lanceolate to lanceolate, 2.2–14 by 0.7–2.8 cm; apex acute or acuminate, the actual tip emarginate, obliquely rounded at the base; midrib 3–6 mm distant from the upper margin; slightly to distinctly hairy beneath, often only on the main nerves and/or midrib. *Inflorescences* c. 4 cm long and wide, the rachis 2–3 cm; bracts 1–4 cm long, silky hairy; bracteoles 8(–15) mm long; pedicels 7–9(–25) mm, hairy. *Hypanthium* 9–10 mm deep, glabrous, splitting lengthwise as fruit develops. *Sepals* 10 mm long, glabrous or sparsely hairy. *Petals* white, 9 mm long. *Stamens* 25–35; filaments 22 mm, connate at the base for 1.5–3 mm (almost free, cf. Harms, l.c.); anthers apiculate. *Ovary* sessile, completely enclosed by the hypanthium; style 24 mm. *Fruits* ± kidney-shaped, 3–3.7 by 1.7–3 by 1.3–1.6 cm. — **Fig. 40a.**

Distribution — *Malesia*: New Guinea (Irian Jaya: Vogelkop?, Mimika?; Papua New Guinea: W & E Sepik and Madang Provinces).

Habitat & Ecology — Once recorded from 70 m altitude. Fl. Sept.; fr. June.

12. *Maniltoa schefferi* K. Schum.

Maniltoa schefferi K. Schum. in K. Schum. & Holtr., Fl. Kais. Wilh. Land (1889) 101; in K. Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzgeb. Südsee (1905) 275; Meeuwen, Blumea 18 (1970) 44; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 70, f. 16, 17. — *Pseudocynometra schefferi* (K. Schum.) Kuntze, Deutsch. Bot. Monatsschr. 21 (1903) 173. — Lectotype (Knaap-van Meeuwen 1970); *Teijsmann s.n.* (L), Irian Jaya.

Maniltoa grandiflora auct. non (A. Gray) Scheff.: Scheff., Ann. Jard. Bot. Buitenzorg 1 (1876) 20, quoad descr.; K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee (1900) 347.

Maniltoa hollrungii Harms, Notizbl. Berl.-Dahl. 3 (1902) 189. — *Pseudocynometra hollrungii* (Harms) Kuntze, Deutsch. Bot. Monatsschr. 21 (1903) 173. — Type: *Hollrung 689* (B holo, lost; no duplicates known), Papua New Guinea.

Tree up to 42(–50) m high and 50 cm in diam.; buttresses up to 1 m high. *Leaves* (1–)2–4-jugate. *Stipules* 25–35 by 1–2 mm, very early caducous, leaving no scars; petiole 1.5–2.5 cm, puberulous, glabrescent; rachis 5–16(–25) cm and petiolules 0.2–1 cm, both usually glabrous, sometimes puberulous; the rachis prolonged as a long hispid tendril right after the unfolding of the bud, but soon dropped. *Leaflets* ovate, elliptic, oblong, or lanceolate; apex acuminate, the actual tip usually emarginate; midrib at 1.3–2.5 cm from the upper margin; nerves 6–9 pairs. *Inflorescences* 5.5–9 cm long, the rachis 2–6 mm, more or less pubescent; bracts 0.5–5 cm long, appressed-hairy, sometimes glabrescent; bracteoles 5–1.5 cm long, pubescent, sometimes glabrescent; pedicels 1.5–3 cm, pubescent. *Sepals* 6.5–18 mm, glabrous or hairy. *Petals* 8–11 mm long, white or whitish pink. *Stamens* 30–35; filaments 14–18 mm, the basal 0.75 mm connate; anthers apiculate. *Ovary* pubescent to glabrous; stipe 2–5 mm; style 5–10 mm. *Fruits* compressed ovoid, 2.5–7.5(–9) cm long.

a. var. *schefferi*

Fruits 2.5–3.5 by 1.5–2.5 by 0.3–1.5 cm.

Distribution — Australia (N Queensland), Solomon Islands (Guadalcanal, Choiseul), Bismarck Archipelago (New Ireland); *Malesia*: Celebes, Moluccas (Morotai, Halmahera, Bacan, Ambon, Tanimbar Is., Kei and Aru Is.), New Guinea (West Irian: Vogelkop, Geelvink Bay, Jayapura, Fakfak; Papua New Guinea: W Sepik, Morobe and Central Provinces).

Habitat & Ecology — Forests, 30–720(–960) m altitude. Fl. Feb., March, June–Dec.; fr. Jan., March, April, June, Aug.–Nov.

b. var. *peekelii* (Harms) Verdc.

Maniltoa schefferi K. Schum. var. *peekelii* (Harms) Verdc., Kew Bull. 32 (1977) 240; Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 71. — *Maniltoa peekelii* Harms, Bot. Jahrb. 55 (1917) 50; Peekel (transl. E.E. Henty), Fl. Bismarck Arch. (1984) 211, f. 342, 343, 345. — Type: *Peekel 841* (B holo, lost; duplicate not found), New Ireland.

Fruits up to 7.5(–9) by 5(–6) by 3(–4) cm.

Distribution — New Ireland, New Britain, and Papua New Guinea (E Sepik Prov.).

Habitat & Ecology — Flat land behind beach. Fl. May–July; fr. Feb., May.

13. *Maniltoa steenisii* Meeuwen

Maniltoa steenisii Meeuwen, Blumea 18 (1970) 41; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 71. — Type: *Hoogland 4581* (BRI holo), Papua New Guinea.

Small to medium-sized *tree*, 4–7.5(–13) m high, 5–12 cm in diam. *Stipules* only found together with the young limp leaves, 13–17 by 2–3 mm, ending in a filiform acumens 10–17 mm long, very early caducous, leaving no scar. *Leaves* (1- or 2- or 3-jugate, the rachis projected into a 2 cm long, caducous, filiform prolongation beyond the upper pair of leaflets in unfolding buds; rachis 1.5–4 cm and petiole 0.5–0.9 cm, both hairy. *Leaflets* elliptic to lanceolate, 3–10 by 1.2–3.5 cm, sessile, glabrous except for sparsely hairy along the margin up to halfway; apex obliquely acuminate, the extreme apex apiculate or obliquely emarginate, sometimes obtuse or mucronate; base rounded to auriculate on the basiscopic side; midrib very excentric, at 1.2–5 mm from the acroscopic margin; nerves only visible in the broader part and especially beneath, 3 or 4 pairs. *In-florescences* up to 3 cm long, the rachis 1–2 cm, densely hairy; bracts 0.2–2.2 cm long, sparsely hairy, glabrescent; bracteoles 0.3–1.2 cm long; pedicels (5–) 9–15 mm. *Hypanthium* 1–1.5 mm deep, pedicels and hypanthium loosely to densely hairy, sometimes glabrescent. *Flowers* white to pink. *Sepals* 7–10 mm, loosely hairy. *Petals* 7–10 mm long, occasionally hairy at tip. *Stamens* 15–18, not connate at the base; filaments 8 mm, sometimes with a few hairs; anthers apiculate. *Ovary* 3–5 by 2–2.5 mm, sparsely hairy or glabrous, stipe 2–4 mm; style 8–14 mm glabrous. *Fruits* 3.2 by 2.3 by 0.8–1 cm.

a. var. *stenisii*

Leaflets lanceolate, up to 10 by 3.5 cm, acuminate, the upper and back margins meeting at the apiculate apex.

Distribution — *Malesia*: Moluccas?, New Guinea (Irian Jaya: Snow Mts; Papua New Guinea: Western, Gulf, Central and Northern Provinces).

Habitat — Rain forest, 25–90 m altitude. Fl. April, May, Aug., Sept.; Fr. June.

b. var. *rodneyensis* Verdc.

Maniltoa steenisii Meeuwen var. *rodneyensis* Verdc., Kew Bull. 32 (1977) 241; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 74. — Type: *Henty NGF 38561* (LAE holo; A, BISH, BO, BRI, CANB, K, L, NSW, SING), Papua New Guinea.

Leaflets more elliptic, 3–4.5 cm by 1–1.7 cm, not acuminate, the upper margin not reaching the tip of the leaflet.

Distribution — *Malesia*: Papua New Guinea (Central Prov.).

Habitat & Ecology — Forest, 60–240 m altitude. Fr. Feb.

INCOMPLETELY KNOWN TAXA

There are sterile or incomplete Malesian specimens of *Maniltoa*, mainly from New Guinea, in many herbaria. Verdcourt [Manual New Guinea Leg. (1979) 75–77] made a comprehensive study of the genus and expressed that “it must be emphasized that only

complete material is of any value in this genus." He has recorded several undescribed taxa of this genus from New Guinea, under the species A to H, hoping fertile or complete collections will be available in the near future.

PELTOPHORUM

(Ding Hou)

Peltophorum (Vogel) Benth., J. Bot. 2 (1840) 75, nom. cons.; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 90; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 47. — *Caesalpinia* sect. *Peltophorum* Vogel, Linnaea 11 (1837) 406. — Type species: *Caesalpinia dubia* Spreng. [= *Peltophorum dubium* (Spreng.) Taub.].

Baryxylum Lour., Pl. Cochinch. (1790) 266, nom. rejic. — Type species: *Baryxylum rufum* Lour.

Trees, unarmed. *Leaves* bipinnate, deciduous. *Stipules* lobed or branched, often persistent at anthesis, or small and caducous. *Leaflets* small, numerous, opposite. *Inflorescences* terminal and/or axillary, simple racemose or paniculate; bracts present, sometimes caducous; bracteoles lacking. *Flowers* hermaphrodite, showy. *Hypanthium* very short or obscure. *Calyx* deeply 5-lobed. *Petals* 5, yellow, more or less equal, imbricate, spreading. *Stamens* 10, free; filaments thickened and pilose at the basal part; anthers uniform, dorsifixed, longitudinally dehiscent. *Ovary* sessile or substipitate, 3–8-ovuled; style filiform, incurved; stigma prominent, peltate or capitate. *Pods* oblong, hard, compressed, indehiscent, with a firm, wing-like extension on each suture, usually longitudinally striate, 1–6-seeded. *Seeds* lenticular, compressed, exalbuminous.

Distribution — A pantropic genus of c. 15 species, three occurring in *Malesia*.

KEY TO THE SPECIES

- 1a. Inflorescences/infructescences paniculate, terminal and axillary. Pedicels usually 5–7 mm **2. *P. pterocarpum***
- b. Inflorescences/infructescences racemose, axillary. Pedicels longer, 10–40 mm 2
- 2a. Leaves with 3–5 pairs of pinnae; stipules linear, caducous. Pedicels short, 10–12 mm. Petals suborbicular, subreniform, or broadly obovate, 12–16 mm long and wide. Seeds longitudinally positioned in the pod **3. *P. racemosum***
- b. Leaves with 5–9 pairs of pinnae; stipules lobed and usually relobed, often persistent at anthesis. Pedicels 20–40 mm. Petals obovate, 15–25 by 10–12 mm. Seeds more or less transversely positioned in the pod **1. *P. dasyrhachis***

1. *Peltophorum dasyrhachis* (Miq.) Kurz

Peltophorum dasyrhachis (Miq.) Kurz, J. As. Soc. Beng. 45, ii (1876) 128 & (1877) 293; Koord. & Valetton, Bijdr. Booms. Java 1 (1894) 270; Prain, J. As. Soc. Beng. 66, ii (1897) 224; Ridley, Fl. Malay Penins. 1 (1922) 647; Backer & Bakh. f., Fl. Java 1 (1964) 547; Whitmore in Tree Fl. Malaya 1 (1972) 267; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 60, pl. 11/1–6; in Fl. Thailand 4 (1984) 54, f. 12/1–6, pl. II/3; Rudd in Fl. Ceylon 7 (1991) 58. — *Caesalpinia dasyrhachis* Miq., Fl. Ind. Bat., Suppl. (1861) 292. — Type: *Teijsmann s.n.* (L holotype; K), Sumatra.

Peltophorum grande Prain, J. As. Soc. Beng. 66, ii (1897) 471. — Type: *Forbes 3163* (L iso), Sumatra.

Tree up to 30 m high; young branchlets brownish red tomentose, glabrescent. *Stipules* lobed or branched. *Leaf* rachis up to 32 cm and petiole up to 5.5(–7) cm, both tomentose; pinnae 5–9 pairs. *Leaflets* 6–16 pairs per pinna, sessile, oblong or elliptic-oblong, 10–25 by 4–10 mm, obtuse or slightly emarginate at apex, acute, obtuse or rounded at base; finely pubescent on both surfaces, glabrescent, sometimes almost glabrous above. *Inflorescences* lateral, racemose, 15–30 cm long, rachis pubescent; bracts linear 10–12 mm long, more or less persistent; pedicels 20–40 mm. *Calyx* lobes 10–15 by 5–6 mm, tomentose outside. *Petals* yellow, obovate, 15–25 by 10–12 mm, hairy towards the base of the inner side. *Stamens* with filaments 10–15 mm; anthers 4–5 mm long. *Ovary* sessile, c. 5 mm long, velutinous, 4–8-ovuled; style c. 12 mm. *Pods* reddish brown, elliptic, 10–15 by 2–4 cm (including the wing-like margin), tapering towards both ends, brown-pubescent, glabrescent, not or indistinctly striate, the marginal wing 4–5 mm broad. *Seeds* 4–8, flat, 1–12 by 5 mm, more or less transversely positioned in the pod.

Distribution — Thailand, Cambodia, Laos, Vietnam; *Malesia*: Sumatra, Malay Peninsula, Borneo (Sabah, Sarawak, Kalimantan).

Habitat & Ecology — In deciduous and evergreen forests at lower altitudes. Fl. Feb.–July, Nov., Dec.; fr. Jan., March, May, June, Dec.

Uses — Introduced in many places in the tropics. In Java cultivated in coffee and cacao plantations as shade trees. See Burkill, *Diet. Econ. Prod. Malay Penins.* (1935) 1714; K. Heyne, *Nutt. Pl. Indon.*, ed. 3 (1950) 754.

2. *Peltophorum pterocarpum* (DC.) K. Heyne

Peltophorum pterocarpum (DC.) Backer ex K. Heyne, *Nutt. Pl. Ned.-Ind.*, ed. 2 (1927) 755; Backer & Bakh. f., *Fl. Java* 1 (1964) 547; Whitmore in *Tree Fl. Malaya* 1 (1972) 268, f. 2; Hattink, *Reinwardtia* 9 (1974) 59; Cockb., *Trees Sabah* 1 (1976) 175, f. 38; Verdc., *Manual New Guinea Leg.*, *Lae Bot. Bull.* 11 (1979) 16; K. & S.S. Larsen in *Fl. Camb., Laos & Vietnam* 18 (1980) 62, pl. 11/8–11; in *Fl. Thailand* 4 (1984) 54, f. 12/7–10; Rudd in *Fl. Ceylon* 7 (1991) 57. — *Inga pterocarpa* DC., *Prodr.* 2 (1825) 441. — Type: incompletely annotated specimen from Timor (P holotype; K).

Caesalpinia inermis Roxb., *Fl. Ind.*, ed. Carey, 2 (1832) 367. — *Peltophorum inerme* (Roxb.) Llanos in Blanco, *Fl. Filip.*, ed. 3 (1877–83) t. 335; Merr., *Philipp. J. Sc., Bot.* 5 (1910) 57. — Type: unknown.

Caesalpinia ferruginea Decne., *Nouv. Ann. Mus. Hist. Nat.* 3 (1834) 462; *Herb. Timor descr.* (1835) 134; Miq., *Fl. Ind. Bat.* 1, 1 (1855) 111. — *Peltophorum ferrugineum* (Decne.) Benth., *Fl. Austral.* 2 (1864) 279; Koord. & Valetton, *Bijdr. Booms. Java* 2 (1895) 3, incl. var. *glanduliferum* Koord. & Valetton; Koord., *Atlas* 1 (1913) f. 22; Ridley, *Fl. Malay Penins.* 1 (1922) 646. — Type: *Anonymus s.n.* (P holotype; K), Timor.

Caesalpinia arborea Zoll. ex Miq., *Fl. Ind. Bat.* 1, 1 (1855) 112. — Type: *Zollinger 2897*, Java (Malang).

Tree up to 35 m high and 80(–100) cm in diam., deciduous; young shoots ferruginous pubescent or tomentose, glabrescent. *Stipules* small, linear, not branched, caducous. *Leaf* rachis up to 26 cm and petiole up to 10 cm; pinnae 4–14 pairs. *Leaflets* (8–)10–15 (–22) pairs per pinna, sessile, oblong, 10–20 by 3–10 mm, obtuse, rounded or slightly emarginate at the apex, unequally acute or attenuate, or rounded at the base; nearly gla-



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Fa. P. W. M. Trap impr.

brous above, finely pubescent, glabrescent beneath. *Inflorescences* terminal and axillary, paniculate, up to 40 cm long, densely ferrugineous pubescent; bracts minute, deltoid, 5–8 mm long, caducous; pedicels usually 5–7 mm. *Calyx* lobes slightly triangular, 5–8 by 5–6 mm, pubescent outside. *Petals* bright yellow, obovate, 17–25 by 10–13 mm, densely hairy towards the basal part. *Stamens*: filaments 12–15 mm; anthers 3 mm long. *Ovary* stipitate, hairy, 3- or 4-ovuled. *Pods* oblong-elliptic, up to 14 by c. 2.5 cm (including the wing-like margin), acute at the apex, tapering towards the base, often slightly constricted between seeds (for pods with 2 or more seeds), longitudinally striate, pubescent, glabrescent or almost glabrous, the wing-like margin 4–5 mm wide, 1–4-seeded. *Seeds* oblong, flat, 10–12 by 5 mm, light brown, longitudinally positioned in the pod. — **Fig. 41.**

Distribution — Sri Lanka, Thailand, Cambodia, S Vietnam; throughout *Malesia* to northern Australia.

Habitat & Ecology — Frequently growing along beaches and behind the mangroves, often in lowland, open forests, occasionally found on limestone plateau. Fl. and fr. throughout the year.

Uses — Widely introduced and cultivated in the tropics. Planted as a shade tree in plantations and as a very attractive ornamental in parks and along roadsides. Barks used for dyes and for various medicinal purposes. See Burkill, Dict. Econ. Prod. Malay Pénins. (1935) 1715; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 755.

3. *Peltophorum racemosum* Merr.

Peltophorum racemosum Merr., Philipp. J. Sc., Bot. 11 (1916) 84; Meijer, Field Guide Trees W Mal. (1974) 191; Cockb., Trees Sabah 1 (1976) 175. — Type: *Hub. Winkler 2424* (L iso), Borneo.

Tree up to 60 m high and 80 cm in diam., buttresses flat, c. 1 m high, 1 m extending outward, 4 cm thick; young shoots prominently ferrugineous-pubescent. *Stipules* lanceolate to linear, c. 5 mm long, caducous. *Leaf* rachis up to c. 20 cm and petiole up to c. 10 cm; pinnae 3–5 pairs, up to c. 10 cm long. *Leaflets* 4–11 pairs per pinna, sessile or subsessile, coriaceous, equilateral or nearly so, oblong, oblong-elliptic, 20–30(–60) by 8–12(–25) mm, broadly rounded and minutely apiculate at the apex, subacute or obtuse at the base; upper surface glabrous except sometimes slightly hairy on the midrib, the lower covered with short, appressed hairs; lateral nerves up to c. 14 per side, visible or distinct on both surfaces. *Inflorescences* axillary, solitary, racemose, up to c. 27 cm long, rachis ferrugineous-pubescent; bracts triangular, c. 3 mm long, caducous; pedicels 10–12 mm. *Hypanthium* shortly discoid, c. 5 mm in diam. *Calyx* densely ferrugineous-pubescent outside, lobes oblong, 7–10 by 4–5 mm, inside the lower half pubescent. *Petals* suborbiculate, subreniform, or broadly obovate, 12–16 mm long and wide, much wrinkled, pubescent at the lower half outside and at the basal part inside, rounded and

Fig. 41. *Peltophorum pterocarpum* (DC.) Backer ex K. Heyne. a. Leafy branchlet; b. inflorescence; c. leaflets; d. opened pod. Reproduced from Koorders, Atlas 1: f. 22.

crose at the apex and margins, the basal 2–3 mm narrowed and claw-like, with distinct, palmate venation. *Stamens*: filaments 7–10 mm; anthers versatile, oblong, 4–4.5 mm long. *Ovary* sessile, elliptic or lanceolate, 4–6 mm long, densely pubescent, 4-ovuled; style 5–8 mm glabrous except the basal part; stigma peltate. *Pods* elliptic, narrow-elliptic, or obovate-elliptic, flat, 12–15.5(–19) by 3–4 cm (including the marginal, c. 5 mm wide wing), acuminate at the apex, attenuate towards the base, loosely pubescent, glabrescent, or almost glabrous. *Seeds* elliptic, flat, c. 2 by 1 cm, longitudinally positioned in the pod.

Distribution — *Malesia*: Borneo (scattered and widespread in Sabah, Sarawak, Kalimantan).

Habitat & Ecology — In lowland primary forests. Fl. April, June; fr. Feb.–Oct.

PTEROLOBIUM

(Ding Hou)

Pterolobium R. Brown [in Salt, Abyss. App. 1814, 64, nom. nud.] ex Wight & Arn., Prodr. Fl. Ind. Orient. 1 (1834) 283, nom. cons.; J.E. Vidal & Hul Thol, Bull. Mus. Hist. Nat. Paris III, 227 (Bot. 15) (1974) 2; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 93; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 50. — Type species: *Pterolobium lacerans* R.Br., nom. illeg. [= *Peltophorum stellatum* (Forssk.) Brenan].

Lianas, climbing shrubs, scramblers, or small *trees*; branchlets and (main) rachides often armed with recurved, paired or singular prickles. *Stipules* and stipels small, inconspicuous, caducous. *Leaves* spiral, bipinnate, petioled; pinnae and pinnules opposite or subopposite, petiolulate. *Leaflets* many, rather small, opposite or subopposite, subsessile, slightly emarginate at apex, unequal at base. *Inflorescences* terminal or axillary, often paniculately aggregated racemes; bracts caducous, bracteoles absent. *Flowers* bisexual, pedicelled, slightly zygomorphic. *Hypanthium* shortly cupular or discoid. *Calyx* lobes 5, imbricate, the lowest (exterior) one concave and larger. *Petals* 5 (usually 4 similar and 1 different, all similar in *P. borneense*), imbricate, the standard (superior, interior one) often slightly contracted and the margins slightly inflexed near the middle. *Disk* obscure or absent. *Stamens* 10, all fertile, free, in one whorl; filaments usually alternately long and short in buds but equal in length in open flowers; anthers oblong, c. 1 mm long, dorsifixed, introrse. *Ovary* sessile or stipitate, free, ellipsoid, slightly flattened and curved, 1- or 2-ovuled; style filiform; stigma small, round, truncate or slightly concave. *Pods* sessile or very shortly stipitate, compressed and samaroid, usually 1-seeded, indehiscent; basal seed-bearing part obliquely or broadly ellipsoid or ovoid; upper, wing-like part, membranous, obliquely more or less oblong or falcate, or elliptic, with slightly transversely curved, obscure or visible veins, one margin thickened and slightly straight, the other thin and slightly convex. *Seeds* lenticular, flattened, smooth, exalbuminous.

Distribution — A genus consisting of about 11 species, distributed in the Old World: S & E Africa, Arabia (Yemen) (only 1 sp.), India (1 sp.), China (c. 2 spp.), Burma, Thailand and Indochina (4 spp.); *Malesia* (5 spp. in Sumatra, Malay Peninsula, Borneo, Java, Philippines, Lesser Sunda Islands).

Habitat — In lowland forest, up to 500 m altitude; outside Malesia sometimes found at 500–1000 m, rarely up to 1500 m.

Note — The genus *Pterolobium* is closely related to *Caesalpinia* (incl. *Mezoneuron*). It can be distinguished from the latter by 1) the pods samaroid or with a well developed terminal wing (against pods wingless, with a rudimentary wing, or with a narrow, lateral wing), and 2) ovary slightly curved (against ovary rectilinear). See J.E. Vidal & Hul Thol, l.c.

KEY 1 TO THE SPECIES

(Based on flowering specimens)

- 1a. Leaflets crenulate; nerves and veins well visible on both surfaces **4. *P. membranulaceum***
- b. Leaflets entire; veins usually invisible on both surfaces 2
- 2a. Leaflets 12–25 per pinna, punctate **5. *P. microphyllum***
- b. Leaflets often 4–10, rarely up to 12–14, per pinna, not punctate 3
- 3a. Petals all similar (in shape and size), glabrous **1. *P. borneense***
- b. Petals not all similar: only 4 of them similar (in shape and size) and the standard or superior one different, puberulous usually on the central and/or lower part(s) inside and also on the margins 4
- 4a. Inflorescences densely flowered. Pedicels 5–6 mm **2. *P. densiflorum***
- b. Inflorescences loosely flowered. Pedicels 10–15 mm **3. *P. macropterum***

KEY 2 TO THE SPECIES

(Based on fruiting specimens)

- 1a. Leaflets crenulate; nerves and veins well visible on both surfaces **4. *P. membranulaceum***
- b. Leaflets entire; nerves and veins usually invisible on both surfaces 2
- 2a. Leaflets 12–25 per pinna, punctate **5. *P. microphyllum***
- b. Leaflets often 4–10, rarely up to 12–14, per pinna, not punctate 3
- 3a. Pods stipitate (1.5–3 mm), the wing gradually narrowed along one side of the seed-bearing part towards its upper 1/3–1/2 **3. *P. macropterum***
- b. Pods sessile, the wing gradually narrowed along one side of the seed-bearing part towards its base 4
- 4a. Seed-bearing part reticulate **1. *P. borneense***
- b. Seed-bearing part usually not reticulate **2. *P. densiflorum***

1. *Pterolobium borneense* Merr.

Pterolobium borneense Merr., Philipp. J. Sc., Bot. 11 (1916) 88; J.E. Vidal & Hul Thol, Bull. Mus. Hist. Nat. Paris III, 227 (Bot. 15) (1974) 16, t. 2: 14. — Type: *Native Collector BS 2761* (specimen extant?, A photo), Sarawak.

Ding Hou, '95

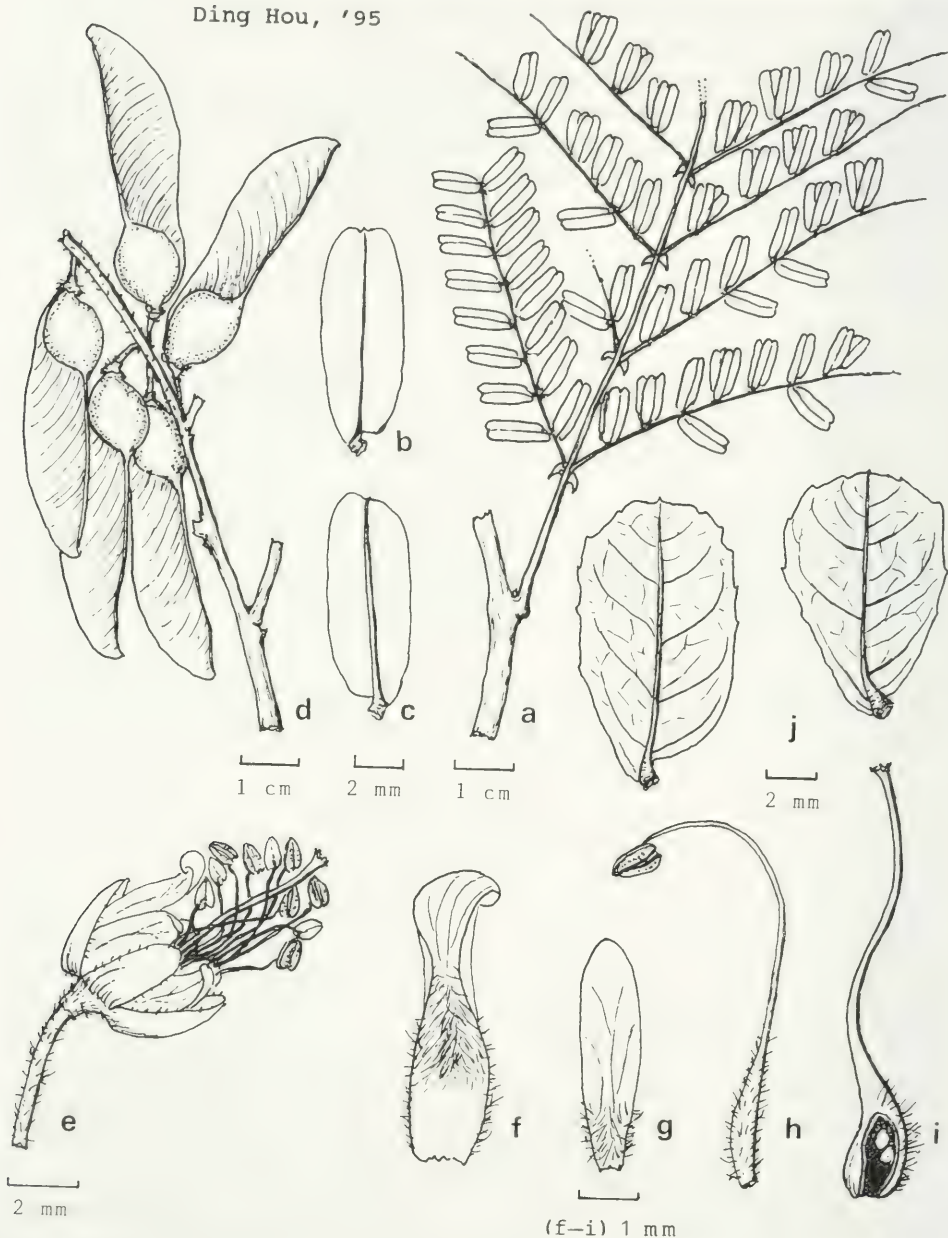


Fig. 42. *Pterolobium densiflorum* Prain. a. Part of leaf; b, c. upper and lower surfaces of leaflet; d. part of infructescence; e. flower; f. upper petal (standard); g. lateral petal; h. stamen; i. pistil, with ovary cut longitudinally showing two ovules. — *Pterolobium membranulaceum* (Blanco) Merr. j. Lower surfaces of two forms of leaflets (a–i: de Wilde & de Wilde-Duyffjes 14433; j: Merrill Sp. Blanco. 454). Drawing Ding Hou.

Scandent shrub or liana. Leaves: petiole and main rachis up to c. 20 cm long, puberulous; pinnae c. 10 pairs, petiole and rachis, 4–6 cm long, puberulous. *Leaflets* 10–14 pairs per pinna, oblong, c. 10 by 5 mm, entire, glabrous, nerves and veins invisible. *Inflorescences* 25 cm long, rachis and branchlets pubescent, densely flowered; pedicels 2–3 mm, sparsely puberulous. *Flowers* seen rather young. *Hypanthium* c. 1 mm high, sparsely puberulous. *Calyx* lobes oblong, 2.5–3 by 0.75–1 mm, glabrous except slightly ciliate on the margins. *Petals* all similar, oblong, c. 2.3 by 0.3 mm, glabrous. *Stamens:* filaments 0.6–1.5 mm; anthers c. 1 mm long. *Ovary* sessile, c. 1 mm long, glabrous, 2-ovuled; style c. 1.5 mm, glabrous. *Pods* not stipitate; seed-bearing part sub-orbicular or broadly ellipsoid, 1.4–1.6 by 1.2–1.4 cm, glabrous, obscurely reticulate; wing 4.5–5.5 by c. 1.5 cm, the basal part gradually narrowed along one lateral side of the seed-bearing part towards its base. *Seeds* c. 9 by 8 mm.

Distribution — *Malesia:* Borneo (Sarawak, Kalimantan).

Habitat & Ecology — In lowland forest, up to 80 m altitude. Fl. Nov.; fr. Oct., Nov.

Notes — 1. The flowers of the present species are rather similar to those of *Caesalpinia*.

2. The present species is closely allied to *Pterolobium densiflorum*; with the limited collections of these two species examined, it is not easy to distinguish them especially with fruiting material.

2. *Pterolobium densiflorum* Prain

Peltophorum densiflorum Prain, J. As. Soc. Beng. 66, ii (1897) 236, 473; Ridley, Fl. Malay Penins. 1 (1922) 648; J.E. Vidal & Hul Thol, Bull. Mus. Hist. Nat. Paris III, 227 (Bot. 15) (1974) 20, t. 3: 19–21. — Lectotype (J.E. Vidal & Hul Thol 1974): *Curtis 3093 B* (K holo; L photo), Penang I.; syntype: *Maingay 535* (BM, K, L iso), Malay Peninsula.

Liana or straggling shrub up to 20 m high. *Leaves:* petiole and main rachis 12–26 cm long, puberulous, glabrescent; pinnae 4–10(–16) pairs, petiole and rachis 4–8 cm long, puberulous. *Leaflets* 8–12 pairs per pinna, oblong, 8–13 by 3.5–5 mm, entire, nerves and veins invisible. *Inflorescences* 16–30 cm long, densely flowered, the rachis and branches puberulous, glabrescent; pedicels 5–6 mm. *Hypanthium* c. 1 mm high, sparsely puberulous. *Calyx* lobes oblong or oblong-ovate, c. 4 by 2 mm, sparsely puberulous outside, ciliate on the margins. *Petals:* standard slightly oblong or oblanceolate, c. 5.5 by 1.5 mm, thicker than the others, margins inflexed near the central part, glabrous outside, puberulous on the central part inside; the others oblanceolate, c. 4 by 1 mm, puberulous at the base inside and on the basal margins. *Stamens:* filaments 4–7 mm, the lower 1/3–2/3 hairy; anthers c. 1 mm long. *Ovary* sessile, c. 2 mm long, glabrous or sparsely puberulous on placental side, 2- or 1-ovuled; style 5–7 mm. *Pods* not stipitate; seed-bearing part broadly ellipsoid or suborbicular, 1.6–2 by 1.2–1.8 cm, glabrous, reticulate; wing 5–5.6 by 1.3–1.8 cm, the basal part gradually narrowed along the lateral side of the seed-bearing part towards almost its base. *Seeds* c. 8 by 7 mm. — **Fig. 42a–i.**

Distribution — *Malesia:* Sumatra (Aceh, Tapianuli), Malay Peninsula (Selangor, Malacca, and Penang I.).

Habitat — In lowland forest, disturbed forest, hillsides, once recorded occurring in mesotrophic forest over craggy limestone with deep soil pockets (*FRI 15635*), up to 400 m altitude.

3. *Pterolobium macropterum* Kurz

Pterolobium macropterum Kurz, J. As. Soc. Beng. 42, ii (1873) 71; Backer & Bakh. f., Fl. Java 1 (1964) 543; J.E. Vidal & Hul Thol, Bull. Mus. Hist. Nat. Paris III, 227 (Bot. 15) (1974) 22, t. 4: 9–14; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 56, pl. 10/1–7; in Fl. Thailand 4 (1984) 59, f. 14/1–7, pl. II/4. — *Pterolobium indicum* A. Rich. var. *macropterum* (Kurz) Baker in Hook. f., Fl. Brit. India 2 (1878) 259. — *Cantuffa macroptera* (Kurz) Kuntze, Rev. Gen. Pl. 1 (1891) 168. — Type: Kurz 2570 (K, L photo), Burma.

Pterolobium lacerans auct. non R.Br.: Miq., Fl. Ind. Bat. 1, 1 (1855) 106, based on *Horsfield s.n.* (BM, K, L photo), Java.

Liana up to 15(–30) m high. *Leaves*: petiole and rachis (10–)14–25 cm long, pubescent; pinnae 5–9 pairs. *Leaflets* 4–6(–10) pairs per pinna, oblong or oblong-elliptic, 7–15 by 4–9 mm, entire, glabrous above, sparsely pubescent along the midrib and often with a tuft hair at the base on one side of the midrib; nerves and veins invisible or obscure on both surfaces. *Inflorescences* 15–30 cm long, rachis and branchlets pubescent, glabrescent, or glabrous, loosely flowered; pedicels 10–15 mm. *Hypanthium* 1.5–2 mm high, glabrous outside. *Calyx* lobes oblong, 4–4.5 by 1.5–2 mm, glabrous except puberulous on the lower surface inside and ciliate on the margins. *Petals*: standard obovate, 4.5–6 by 2.5–3.5 mm; the others obovate, 4.5–6.5 by 2–3 mm, glabrous. *Stamens*: filaments 6.5–8.5 mm, usually hairy at the lower 1/2–2/3. *Ovary* c. 3 mm long, very shortly stipitate, puberulous, 1-ovuled; style 6–7 mm, sparsely puberulous. *Pods* shortly stipitate (stipe 1.5–3 mm); seed-bearing part 1.7–2 by 0.8–1.4 cm, reticulate, glabrous; wing 3.5–4.5 by 1–2 cm, basal part gradually narrowed along one lateral side of the seed-bearing part towards its upper 1/3–1/2. *Seeds* only immature seen.

Distribution — India (incl. Andaman Islands), S Burma, Thailand, Laos, S Vietnam; *Malesia*: S & C Java.

Habitat & Ecology — In light forest and thickets, up to 300 m altitude. Fl. (no data for Malesian plants seen); fr. Nov. Dec.

4. *Pterolobium membranulaceum* (Blanco) Merr.

Pterolobium membranulaceum (Blanco) Merr., Publ. Govt. Lab. Philipp. 35 (1906) 22; Philipp. J. Sc., Bot. 5 (1910) 52; Sp. Blanc. (1918) 175; J.E. Vidal & Hul Thol, Bull. Mus. Nat. Hist. Nat. III, 227 (Bot. 15) (1974) 23, t. 4: 15 & 16. — *Mimosa membranulacea* Blanco, Fl. Filip., ed. 1 (1837) 739. — *Reichardia pentapetala* Blanco, Fl. Filip. ed. 2 (1845) 233, ed. 3, 2 (1878) 71, nom. nov. — Neotype (J.E. Vidal & Hul Thol 1974): Merrill, Sp. Blanco. 454 (L iso); syn(neo)type: Merrill, Sp. Blanco. 664 (L iso); both Luzon.

Pterolobium indicum auct. non A. Rich.: Fern.-Vill., Nov. App. (1880) 70; Vidal, Sinopsis Atlas (1883) 24, t. 42 G; Rev. Pl. Vasc. Filip. (1886) 114; Merr., Philipp. Govt. Lab. Bur. Bull. 27 (1905) 41.

Liana. *Leaves*: petiole and main rachis 10–21 cm long, pubescent; pinnae 5–10 pairs, long, pubescent. *Leaflets* (4–)6–8 pairs per pinna, oblong, rarely obovate, 8–13 by

4–8 mm, crenulate, glabrous; nerves c. 5 pairs, both nerves and veins well visible on both surfaces. *Inflorescences* terminal and axillary, 10–35 cm long, loosely flowered, pubescent; bracts narrowly lanceolate, c. 2 mm long; pedicels 6–8 mm, sparsely puberulous, glabrescent. *Hypanthium* c. 1 mm long, glabrous. *Calyx* lobes oblong or oblong-ovate, 4–5 by 1.75–2 mm, glabrous outside, puberulous on lower part inside. *Petals*: standard obovate, c. 4 by 2.5 mm, with the margin slightly inflexed near the middle, glabrous outside, slightly puberulous inside and on the margins near the base; others similar one another, obovate, c. 4 by 1.75 mm, glabrous except ciliate on the margins near the base. *Stamens*: 7–9 mm, densely hairy except the apical part; anthers oblong, c. 0.8 mm long. *Ovary* c. 2 mm long, shortly stipitate, glabrous except on the placental side, 1-ovuled; style 5–7 mm. *Pods* stipitate (stipe c. 2 mm); seed-bearing part elliptic, 1.5–1.8 by 0.8–1 cm, glabrous, obscurely, loosely reticulate; wing 3–3.5 by 1–1.3 cm, basal part narrowed along one side towards half of the fertile part. *Seeds* seen very young. — **Fig. 42j.**

Distribution — *Malesia*: Philippines (Luzon).

Habitat & Ecology — Found in thickets at low and medium altitude. Fl. Sept.; fr. Nov., Dec.

Note — The stamens are oblique in an open flower, similar to those of *Caesalpinia*.

5. *Pterolobium microphyllum* Miq.

Pterolobium microphyllum Miq., Fl. Ind. Bat. 1, 1 (1855) 106; Backer & Bakh. f., Fl. Java 1 (1964) 543; J.E. Vidal & Hul Thol, Bull. Mus. Hist. Nat. Paris III, 227 (Bot. 15) (1974) 17, t. 3: 1–18; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 54, pl. 9/1–9; in Fl. Thailand 4 (1984) 57, f. 13; Stone, Mal. Nat. J. 37 (1984) 188. — *Pterolobium indicum* A. Rich. var. *microphyllum* (Miq.) Baker in Hook. f., Fl. Brit. India 2 (1878) 259. — *Cantuffa microphylla* (Miq.) Kuntze, Rev. Gen. Pl. (1891) 168. — Lectotype (J.E. Vidal & Hul Thol 1974): *Blume* 1250 (L. holo; P); syntype: *Zollinger* 1236 Z (P), both Java.

Pterolobium insigne Blume ex Miq., Fl. Ind. Bat. 1, 1 (1855), nom. nud., pro syn.

Liana, high climbing *shrub*, or small *tree*. *Leaves*: petiole and main rachis 12–20 (–26) cm long, pubescent, glabrescent; pinnae 7–17 pairs, pubescent. *Leaflets* 12–25 pairs per pinna, oblong, 5–12 by 1.5–3 mm, entire, glabrous, nerves and veins invisible. *Inflorescences* 10–35 cm long, rachis and branchlets pubescent, densely flowered; pedicels 3–8 mm, sparsely puberulous. *Hypanthium* c. 1 mm high, sparsely puberulous outside. *Calyx* lobes oblong-ovate, 3.5–4.5 by 1.75–2, almost glabrous except ciliate on the margins. *Petals*: standard oblong-elliptic, c. 4 by 2 mm, glabrous outside, densely puberulous on the lower half inside and on the margins; the others oblanceolate, 3–4 by 1–1.5 mm, glabrous except puberulous on the lower 1 mm inside and on the margins. *Stamens*: 7–8 mm; filaments hairy at the lower 2 mm; anthers oblong, c. 1 mm long. *Ovary* puberulous or only on the convex side, 2-ovuled; style 6–7 mm. *Pods* not stipitate; seed-bearing part broadly ellipsoid or suborbicular, 1.5–2 by 1–1.5 cm, slightly reticulate, puberulous, glabrescent, or glabrous; wing 5–6 by 1.3–1.8 cm, the basal part gradually narrowed along the margin of the seed-bearing part towards its base. *Seeds* 6.5 by 5.5 mm.

Distribution — Burma (Tenasserim), Thailand (Peninsula), Cambodia, Laos, Vietnam; *Malesia*: Sumatra, Malay Peninsula (Selangor) incl. Langkawi I., Java, Lesser Sunda Islands (Bali, Sumbawa).

Habitat & Ecology — Scattered in forests, open heath country by stream, and thickets on riverbank, up to 500 m altitude (outside *Malesia* up to 1200 m). Fl. June, Nov., Dec.; fr. May–July.

SARACA

(Ding Hou)

Saraca L., Mant. Pl. 1 (1767) 98; Zuijderh., Blumea 15 (1968) 414; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 128; Watson & Dallwitz, Gen. Leg.–Caesalp. (1983) 51. — Type species: *Saraca indica* L.

Jonesia Roxb., Asiat. Res. 4 (1799) 355, cum pl.; Wight, Icon. Pl. Ind. Orient. 1 (1839) t. 206. — Type species: *Jonesia asoca* Roxb. [= *Saraca asoca* (Roxb.) W.J. de Wilde].

Shrubs or *trees*. *Stipules* axillary, enveloping the bud, usually caducous. *Leaves* spiral, paripinnate, 1–7-jugate, petioled. *Leaflets* opposite, sometimes with a pair of wart-like glands at the base and/or at the apex; nerves more or less straight or slightly curved and obliquely upward towards the margin, usually elevated and distinct beneath, less so above; veins reticulate, often visible or distinct beneath, rather obscure above; petiolules very short. *Inflorescences* terminal or axillary, or on older branches, often rather dense, corymbose or paniculate, usually many-flowered; bracts caducous or persistent; bracteoles (sub)opposite, often coloured and showy; pedicels very short. *Flowers* bisexual, or functionally male (with short, small, sterile or rudimentary pistil), distinctly (or sometimes not) articulated at the base. *Hypanthium* cylindrical or tubular. *Calyx* 4(–6)-lobed, subequal, petaloid. *Petals* absent. *Disk* absent. *Stamens* (3 or) 4–8(–10) fertile, in one whorl; filaments free or united at the base into a thin rim or ring-like, more or less equal in length, exserted; anthers ellipsoid, oblong, or broadly ovoid, dorsifixed, introrse, often shortly hairy at apex and/or base, rarely also on the back, or glabrous; staminodes dentate or rarely subulate when present. *Pistil* stipitate, excentric with stipe adnate to the hypanthium; ovary oblong or lanceolate, 2- (in *S. hullettii*) or (4–)6–8(–12)-ovuled; style filiform; stigma terminal, minute, obtuse. *Pods* suborbicular, broadly ovoid, ellipsoid, or obovoid, flattened, straight or distinctly curved, coriaceous or woody, dehiscent, 2-valved, valves twisting and enrolling during dehiscence, 1–8-seeded. *Seeds* ovoid, ellipsoid, or subglobose, smooth, compressed or subterete, exarillate, exalbuminous.

Distribution — A genus of c. 11 closely allied species distributed in India, Sri Lanka, Bangladesh, Burma, Thailand, Cambodia, Laos, Vietnam, China; *Malesia* with 7 indigenous and 1 introduced species: Sumatra, Malay Peninsula, Borneo, Java, Celebes, the Lesser Sunda Islands, Moluccas. Introduced to the Philippines and Papua New Guinea.

Habitat — In lowland forests especially along streams. In the Malay Peninsula the rivers are bordered with *Saraca*-trees forming, tunnel-like through the forest, a characteristic vegetation, called *Saraca*-streams by Corner [Wayside Trees (1940) 42, 400].

Uses — Trees of some species are cultivated in gardens for ornamental purpose. The trees are rather small, so the wood is only used for small utensils.

Notes — 1. The anthers are often (sparsely) hairy at one or both ends, which can be seen as a distinct character for the genus.

2. The number of ovules in the ovary has often been recorded as numerous [e.g. Hutchinson, Gen. Flow. Pl. 2 (1964) 256] or as many (e.g. Zijderhoudt, l.c.). However, the number of ovules is only 2 in *Saraca hullettii* and (4–)6–8(–12) in other species.

KEY TO THE SPECIES

- 1a. Flowers 65–83 mm long; hypanthium (or calyx tube) 55–70 mm long **8. *S. tubiflora***
- b. Flowers much shorter, 6–46 mm long; hypanthium (or calyx tube) 5–32 mm long 2
- 2a. Hypanthium short, 3–7 mm long, about the same length as the calyx lobes. Ovary 2-ovuled. Pods suborbiculate, broadly ovoid or obovoid, or oblong, 4–8 by 3–4 cm, 1- or 2-seeded **4. *S. hullettii***
- b. Hypanthium usually longer, (7–)9–32 mm long, usually 0.5–2 times longer than calyx lobes. Ovary 6–12-ovuled. Pods of other shape, not like above, often longer or larger, usually 15–35(–50) by 5–8(–10) cm, often 4–8- (or more-) seeded 3
- 3a. Filaments and staminodes united at the basal part into a short tube 4–9 mm high. Ovary 6-ovuled. Pods (only one seen) somewhat spindle-shaped, 24 by 5 cm, attenuate at the base **6. *S. monadelpha***
- b. Filaments and staminodes free or obscurely united at the base. Pods of other shape, not like above, varying in size, usually cuneate or obliquely rounded at the base 4
- 4a. Bracts and bracteoles very small, 1–2 mm long, both caducous. Ovary 6-ovuled. Pods oblong or oblong-lanceolate, 15–18 by 5–6 cm. Seeds (only one seen) sub-orbicular, c. 3.7 by 3.1 cm **2. *S. celebica***
- b. Bracts and bracteoles usually much larger, up to 35 mm long, often persistent at least during anthesis, or caducous. Ovary 6–12-ovuled. Pods and seeds varying in shape and size (see below) 5
- 5a. Stamens usually 4, rarely associated with only 3 or up to c. 7. Pedicel length between bracteoles and the flower 2–6(–8) mm 6
- b. Stamens usually 6–8, rarely associated with only 5 or up to 10. Pedicel length between bracteoles and the flower (4–)7–10(–14) mm 7
- 6a. Inflorescences rather big, robust, up to 35(–40) cm wide, the main branches often thick, up to 10 mm in diam. Bracts (to be observed on very young inflorescences) much larger than the bracteoles, oblanceolate, 12–35 by 7–22 mm. Pods narrowly oblong, 15–45(–50) by 3.5–10 cm **7. *S. thaipingensis***
- b. Inflorescences rather smaller, slender, up to 15(–30) cm wide, the main branches rather thin, up to c. 3 mm in diam. Bracts usually smaller than the bracteoles, ovate or obovate, 3–12 by 1.5–7 mm. Pods oblong or lanceolate, 7–31 by 3–7 cm ... **3. *S. declinata***

- 7a. Bracteoles caducous or persistent during anthesis, erecto-patent to spreading, not clasping the pedicel. Ovary 6–8- ovuled. Pods oblong or narrowly oblong-lanceolate, 6–25 by 2–6 cm **5. *S. indica***
- b. Bracteoles persistent during anthesis, erect, clasping the pedicel. Ovary 8–10(–12)-ovuled. Pods oblong or elongate-oblong, or scimitar-shaped, 12.5–25 by 3.5–6.5 cm **1. *S. asoca***

1. *Saraca asoca* (Roxb.) W.J. de Wilde

Saraca asoca (Roxb.) W.J. de Wilde, Blumea 15 (1968) 393, f. 1A; Zuijderh., Blumea 15 (1968) 422, map 3; Whitmore in Tree Fl. Malaya 1 (1972) 269; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 88. — [*Asjogam* Rheede, Hort. Malab. 5 (1685) 117, t. 59.] — *Jonesia asoca* Roxb., Asiat. Res. 4 (1799) 355, t. 252, 253. — *Jonesia pinnata* Willd., Sp. Pl. 2, 1 (1799) 287, nom. illeg. — Type: *Anonymous s. n.* (BR, n.v.), India, cult. in Bot. Gard. Calcutta.

Jonesia confusa Hassk., Retzia 1 (1855) 194, nom. illeg., excl. syn.; Miq., Fl. Ind. Bat. 1, 1 (1855) 1080, pro syn. — *Saraca confusa* (Hassk.) Backer, Voorl. Schoolfl. Java (1908) 103; Schoolfl. Java (1911) 421; Backer & Bakh. f., Fl. Java 1 (1964) 527. — Type: Based on a living plant (origin unknown) cult. in Bot. Gard. Bogor, Java.

Saraca indica auct. non L.: Baker in Hook. f., Fl. Brit. India 2 (1878) 271; Corner, Wayside Trees 1 (1940) 402.

Tree up to 10 m tall and 10 cm in diam., sometimes *shrub* or medium-sized shrub, 4.5 m tall. *Leaves* (1–)4–6-jugate, subsessile to shortly petioled; (petiole and) rachis (0.5–)7–15(–30) cm long. *Leaflets* chartaceous or subcoriaceous, elliptic-oblong or elliptic-lanceolate, or lanceolate, (3.5–)7–18(–26) by (1–)3–5(–9) cm, the lowest pair usually smaller; glabrous; apex acuminate; base cuneate, obtuse, or rounded, symmetric, rarely the lowest pair obscurely subcordate; midrib slightly elevated above, prominent beneath; nerves 5–9(–12) per side; subsessile to petiolules 2–5 mm. *Inflorescences* 1.5–12(–20) cm wide, glabrous, main branches up to c. 6 cm long, 1.5–2 mm diam.; bracts broadly ovate, ovate or obovate, 1–6 by 1–3.5(–5) mm, caducous or persistent, puberulous and/or minutely ciliate on the margin; bracteoles persistent during anthesis, erect, embracing the pedicel, never spreading more than 45° from the pedicel, ovate, elliptic, or obovate, 2–7 by 1.5–4 mm, sparsely puberulous, subglabrous or glabrous except minutely ciliate on the margin; pedicels 8–18 mm, the length between bracteoles and flower (4–)7–10 mm. *Flowers* obscurely or not articulated near the base, subglabrous or glabrous, orange yellow, when older deep orange or orange red, fragrant during the night. *Hypanthium* 9–20 mm long, 1–3 mm wide at the throat. *Calyx* lobes elliptic or obovate, 7–13 by 5–9 mm. *Stamens* (5–)6–8(–10); filaments (10–)17–25 mm, glabrous; anthers ellipsoid or oblong, 1.5–2 mm long; staminodes 0–2. *Pistil* stipitate, free part of stipe 2–4 mm, hairy; ovary 4–6 mm long, puberulous, 8–10(–12)-ovuled; style 15–20 mm, glabrous; stigma capitellate. *Pods* oblong or elongate-oblong (sometimes slightly curved), or scimitar-shaped, 12.5–25 by 3.5–6.5 cm, c. 1 cm thick, leathery or woody, (1–)4–6- (or more-)seeded, with straight or curved, up to c. 1 cm long beaked apex, and cuneate or obliquely rounded base, valves coiling. *Seeds* oblong-ellipsoid, sometimes slightly reniform, 2–3 by 1.25–2 cm, and 0.6–1 cm thick. — **Fig. 43a, b.**



Fig. 43. *Saraca*. Apical parts of inflorescences with corresponding bracteoles. — a, b. *Saraca asoca* (Roxb.) W.J. de Wilde. — c, d. *Saraca indica* L. — e, f. *Saraca celebica* W.J. de Wilde (a, b: herb. Lemann s. n.; c, d: SF 35487; e, f: Eyna 3943). Drawing E. Vijsma. Reproduced from Blumea 15.

Distribution — India, Sri Lanka, Bangladesh, and Burma (west of the Irrawaddy R.). Introduced and cultivated in *Malesia*, specimens seen from Sumatra, Malay Peninsula, Java, Papua New Guinea.

Habitat & Ecology — Outside Malaysia in forest up to c. 500 m altitude, one specimen collected at 1250 m in Sri Lanka, North Central Prov., Ritigala (*Jayasuriya et al. 1343*, L). Flowering and fruiting may occur throughout the year.

Uses — The species is frequently planted near shrines, occasionally in gardens and villages as an ornamental. Its bark, leaves and flowers said to have medicinal properties [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1964; Chadha et al. (eds.), Wealth of India 9 (1972) 232–274].

Notes — 1. In India *Saraca asoca* is often called Asoc (Hind.) and Aoka (Beng.). The species is a sacred tree for the Hindus and it is believed that Buddha was born under its shade.

2. It has been reported that two ovaries were found occasionally to occur in one flower (cf. Zuijderhoudt, l.c.: 423).

2. *Saraca celebica* W.J. de Wilde

Saraca celebica W.J. de Wilde, Blumea 15 (1968) 393, f. 1C; Zuijderh., Blumea 15 (1968) 417, map 1; W.J. de Wilde, Blumea 27 (1981) 235. — Type: *Eyma 3943* (L holotype; SING), Celebes.

Tree 8 m tall. *Leaves* 3- or 4-jugate, shortly petioled (1–1.5 cm), petiole and rachis 7–24.5 cm long. *Leaflets* subcoriaceous, elliptic-oblong to oblong-lanceolate, rarely ovate, 12–28 by 5–13.5 cm; apex acute; base cuneate, obtuse, or rounded, symmetric, or sometimes unsymmetric; glabrous; midrib elevated above, prominent beneath; nerves 6–10 per side; petiolules 4–10 mm. *Inflorescences* 5–14 cm wide, slightly pubescent, glabrescent, or glabrous; branches up to c. 16 cm long; bracts and bracteoles caducous, more or less equal in shape and size, ovate, 1–2 mm long, puberulous outside, minutely hairy on the margin; pedicels 12–22 mm, the length of pedicel between bracteoles and flower 8–18 mm. *Flowers* orange red or red, fragrant, obscurely articulated near the base, slightly puberulous or subglabrous outside. *Hypanthium* 10–15(–20) mm long, 0.5–2 mm wide at the throat, gradually tapering towards the base. *Calyx* lobes elliptic, or ovate-elliptic, 5–10 by 2–8 mm, with minutely hairy margin. *Stamens* 4(–6); staminodes 0–2, when present c. 1 mm; filaments 10–27 mm, glabrous; anthers ellipsoid or oblong, c. 2 mm long; free parts of staminodes (0.5–)1–5 mm. *Pistil* (sometimes reduced) glabrous, stipitate, free part of stipe up to 5 mm; ovary 4–5 mm long, 6-ovuled; style 10–16 mm; stigma minute, round. *Pods* brown, oblong or oblong-lanceolate, 15–18 by 5–6 cm, up to 1.6 cm thick, 1.5–2 cm beaked, obliquely cuneate at base; dried valves somewhat coiled, woody, with distinct, straight and loosely reticulate veins on the outer surface. *Seeds* (only one seen) suborbicular, slightly depressed at the hilum side, c. 3.7 by 3.1 by 1.2 cm, glossy dark brown. — **Fig. 43e, f.**

Distribution — *Malesia*: Celebes (Menado, E Malili, Soekon). Five collections known.

Habitat & Ecology — Along streams, at low altitude up to 100 m. Fl. June, Sept., Oct.; fr. Oct.

Note — The bracts and bracteoles of this species are caducous, so they are mostly not present on a specimen with open flowers or fruits.

3. *Saraca declinata* (Jack) Miq.

- Saraca declinata* (Jack) Miq., Fl. Ind. Bat. 1, 1 (1855) 84, 1080; Ridley, Fl. Malay Pen. 1 (1922) 641; Merr., J. Arnold Arbor. 33 (1952) 228; Zijderh., Blumea 15 (1968) 419, map 5; Whitmore in Tree Fl. Malaya 1 (1972) 269; Cockb., Trees Sabah 1 (1976) 178, f. 38; Verde., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 89; J.E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 133, pl. 23/1–4; in Fl. Thailand 4 (1984) 95, f. 24/1–4, pl. III/3. — *Jonesia declinata* Jack, Mal. Misc. 2 (7) (1822) 74; repr. in Hook., Comp. Bot. Mag. 1 (1836) 223. — Type: *Jack s.n.* (G iso?), Sumatra.
- Saraca macroptera* Miq., Fl. Ind. Bat. 1, 1 (1855) 1080; Ridley, Fl. Malay Penins. 1 (1922) 642. — *Saraca macroptera* var. *typica* Prain, J. As. Soc. Beng. 66, ii (1897) 492, nom. inval. — Type: *Teijsmann 863 HB* (U holo; L photo), Sumatra.
- Jonesia palembanica* Miq., Fl. Ind. Bat., Suppl. (1861) 291. — *Saraca palembanica* (Miq.) Baker in Hook. f., Fl. Brit. India 2 (1878) 272; Ridley, Fl. Malay Penins. 1 (1922) 642; Corner, Gard. Bull. Str. Settl. 10 (1939) 272; Wayside Trees 1 (1940) 402. — Type: *Teijsmann 3976 HB* (U holo; L photo), Sumatra.
- Saraca triandra* auct. non (Roxb.) Baker: Baker in Hook. f., Fl. Brit. India 2 (1878) 272, quoad Malesian specim.; Ridley, Fl. Malay Penins. 1 (1922) 642; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1964; Merr., Univ. Calif. Publ. Bot. 15 (1929) 100.
- Saraca macroptera* var. *parviflora* Prain, J. As. Soc. Beng. 66, ii (1897) 492. — Type: *King's Coll. (Kunstler) 5511* (K holo; L photo), Malay Peninsula.
- Saraca lanceolata* Merr., Univ. Calif. Publ. Bot. 15 (1929) 100. — Type: *Elmer 21718* (iso BM, K, L, U), Sabah.
- Saraca crassifolia* Ridley, Kew Bull. (1933) 491. — Type: *Haviland 1825* (K holo; L), Sarawak.
- Saraca elmeri* Ridley, Kew Bull. (1938) 492. — Type: *Elmer 20707* (K holo; L), Sabah.
- Saraca elegans* Ridley, Kew Bull. (1938) 278. — Type: *Haviland 2905* (K holo; L photo), Sarawak. Paratypes: *Moulton 39* (K), Sarawak; *Henderson 20125* (n.v.), Anambas Islands.
- Saraca longistyla* Ridley, Kew Bull. (1938) 279. — Type: *J.W. Anderson 130* (K holo; L photo), Sarawak. Paratypes: *Haviland 620* (K, L), Sarawak; *Haviland 879* (n.v.), Sarawak.

Tree to 10(–29) m tall and 10(–60) cm in diam., sometimes treelet 3–6 m tall; buttresses very small. *Leaves* (1–)3–5(–7)-jugate, subsessile to shortly petioled; petiole and rachis (4.5–)8.5–56 cm long. *Leaflets* subcoriaceous, elliptic-lanceolate, lanceolate, or oblanceolate 4–30(–50) by 1.5–11(–20) cm, glabrous; apex acuminate, acute, or obtuse; base cuneate, obtuse, or rounded, rarely subcordate for the lowest pair, symmetric; midrib slightly elevated above, prominent beneath; nerves 6–12 per side; often subsessile, sometimes petiolules up to c. 10 mm. *Inflorescences* up to 15(–30) cm wide, slightly pubescent or subglabrous, main branches (1–)7–10(–30) cm long, up to c. 3 mm in diam.; bracts usually smaller than the bracteoles, ovate or obovate, 3–12 by 1.5–7 mm, persistent or caducous, puberulous or minutely ciliate on the margin; bracteoles broadly elliptic, ovate, or sometimes obovate, 4–19 by 3–10 mm, glabrous or minutely ciliate on the margin, persistent, sometimes deciduous; pedicels 10–15(–35) mm, the length between bracteoles and flower 3–6 mm. *Flowers* yellow, orange, pink, pinkish red, fragrant, articulated near the base, puberulous outside. *Hypanthium* 7–15(–32) mm long, 0.5–1.5 mm wide at the throat. *Calyx* lobes ovate, elliptic, or obovate, 6–15 by 3–7 mm. *Stamens* (3 or) 4 (or 5); filaments 16–38 mm, glabrous; anthers ellipsoid or oblong, c. 0.7 mm long; staminodes absent. *Pistil* stipitate, free part of stipe 1.5–4 mm, hairy; ovary 2.5–7 mm long, puberulous, 6–8(–10)-ovuled; style 7–20 mm; stigma minute, round. *Pods* dark brown, oblong or lanceolate, 7–31 by 3–7 cm,



Fig. 44. *Saraca declinata* (Jack) Miq. Leafy branch, inflorescence and pod. Photograph of a water-colour by unknown artist. Original plate in Leiden; photograph B. Kieft, $\times 0.25$.

up to c. 1.2 cm thick, woody, 6–8-seeded, with straight or curved, up to c. 1 cm long beaked apex, and cuneate or obliquely rounded base, the valves coiling. *Seeds* ovoid-oblong, c. 4 by 2 cm, and c. 7 mm thick. — **Fig. 44, 45.**



Fig. 45. *Saraca declinata* (Jack) Miq. Flowering branches. R. Melayata, Sabah. Photograph W. Meijer.

Distribution — Burma (east of the Irrawaddy R.), Cambodia, Laos, Vietnam, Thailand; *Malesia*: Sumatra, Riau, Lingga and Anambas Islands, Malay Peninsula (throughout), Borneo (Brunei, Sarawak, Sabah, Kalimantan), E Java, Lesser Sunda Islands (Flores).

Habitat & Ecology — In primary and mixed dipterocarp forests, often along rivers and streams, sometimes in swamp forests or secondary vegetation, on slope hill, basalt hillside, clay or clay-loam soil, rich soil, and occasionally on slopes of limestone hills, up to 800 m altitude. Fl. and fr. throughout the year.

4. *Saraca hullettii* Prain

Saraca hullettii Prain, J. As. Soc. Beng. 66, ii (1897) 492; Ridley, Kew Bull. (1938) 278; Zijlenderh., Blumea 15 (1968) 418, map 1. — Syntypes: *Hullett 312* (CAL, n.v.), *Haviland s.n.* (CAL, n.v.), *Beccari PB 916* (K iso), all Sarawak.

Tree to 20 m tall and 30 cm in diam. *Leaves* 2- or 3-jugate, subsessile or shortly petioled, petiole and rachis 3–16 cm long. *Leaflets* chartaceous, lanceolate, 5.5–35 by 2–11 cm, apex acuminate rarely caudate; base cuneate to attenuate, sometimes obtuse, symmetric; glabrous; midrib elevated above, prominent beneath; nerves 9–11 per side; petioles 2–10 mm. *Inflorescences* 5–20 cm wide, puberulent, main branches 7–14 cm long; bracts and bracteoles ovate or broadly elliptic, 5–10 by 4–8 mm, glabrous, spreading, persistent; pedicels 22–30 mm, the length between bracteoles and flower 5–11 mm. *Flowers* orange yellow or orange, turning to deep crimson, sweet scented, articulated

near the base, glabrous outside. *Hypanthium* (3–)5.5–7 mm long, c. 2 mm wide at the throat, hairy at the upper half inside. *Calyx* lobes ovate, elliptic, oblong, or obovate, (3–)5–10 by (2–)4–5.5 mm. *Stamens* 4, rarely 3; staminodes absent; filaments 15–25 mm, glabrous; anthers broadly ovoid, c. 0.75 mm long. *Pistil* stipitate, free part of stipe 1.5–5 mm, hairy; ovary 2–4 mm long, 2-ovuled; style 8–12 mm; stigma minute, round. *Pods* red, suborbicular, broadly ovoid or obovoid, or oblong, 4–8 by 3–4 cm, c. 0.5 cm thick, thinly woody, 1- or 2-seeded, with obliquely apiculate apex and rounded base. *Seeds* (young) ovoid, c. 1.5 by 1 cm.

Distribution — *Malesia*: Borneo (Sarawak, Sabah, Brunei, Kalimantan).

Habitat & Ecology — Lowland and riverine forests, often immediately beyond tidal limits, on clayey soil, sand- or limestone, once found on peat, up to 300 m altitude. Fl. Jan., March, April, July–Nov.; fr. July, Oct.

Notes — 1. *Saraca hullettii* can be easily recognized with fertile material by the following characters: 1) leaves 2- or 3-jugate, 2) bracteoles persistent, 3) hypanthium (or calyx tube) short, 3–7 mm long, about the same length as or slightly longer than the calyx lobes, 4) ovary 2-ovuled, and 5) pods suborbicular, shortly oblong, ovoid, or subovoid, 4–8 by 3–4 cm, and 1- or 2-seeded.

2. The present species is the only one known in this genus with a 2-ovuled ovary while the others have an ovary with (4–)6–12 ovules.

5. *Saraca indica* L.

Saraca indica L., Mant. Pl. 1 (1767) 98; W. J. de Wilde, Blumea 15 (1968) 393, f. 1B; Zijderh., Blumea 15 (1968) 423, map 3; Whitmore in Tree Fl. Malaya 1 (1972) 269; J. E. Vidal in Fl. Camb., Laos & Vietnam 18 (1980) 137, pl. 24/1–4; in Fl. Thailand 4 (1984) 97, f. 24/5–7. — Type: *Kleynhoff s.n.* (LINN, n.v.; IDC microfiche), Java.

Saraca arborescens Burm. f., Fl. Ind. (1768) 85, t. 25, f. 2. — Type: *Kleynhoff s.n.* (G, n.v.), Java.

Saraca zollingeriana Miq., Fl. Ind. Bat. 1, 1 (1855) 84. — *Saraca indica* var. *zollingeriana* (Miq.) Gagn. in Fl. Indo-Chine 2 (1913) 211. — Type: *Zollinger 2366* (BM iso, L photo), Java.

Jonesia minor Zoll. & Moritz in Zoll., Nat. Geneesk. Arch. Neêrl. Ind. 3 (1846) 72 ('*M. minor*'), 80. — *Saraca minor* (Zoll. & Moritz) Miq., Fl. Ind. Bat. 1, 1 (1855) 84; Backer & Bakh.f., Fl. Java 1 (1864) 528. — *Saraca minor* var. *typica* Prain, J. As. Soc. Beng. 66, ii (1897) 489. — Type: *Zollinger 3445* (BM, L), Java.

Saraca bijuga Prain, J. As. Soc. Beng. 66, ii (1897) 214; Ridley, Fl. Malay Penins. 1 (1922) 641; Corner, Wayside Trees 1 (1940) 401, f. 134, 135. — *Saraca minor* var. *bijuga* Prain, J. As. Soc. Beng. 66, ii (1897) 489. — *Saraca indica* var. *bijuga* Gagn. in Fl. Indo-Chine 2 (1913) 211. — Syntypes: *King's Coll. (Kunstler) 2749* (n.v.), 2382 & 4059 (K, L), 7221 (K, L); *Wray 2152* (n.v.); *Scortechini 1503* (n.v.), all Malay Peninsula.

Saraca kunstleri Prain, J. As. Soc. Beng. 66, ii (1897) 213, 491; Ridley, Fl. Malay Penins. 1 (1922) 641; Corner, Wayside Trees (1940) 402, p.p. — Type: *King's coll. (Kunstler) 8048* (K, L), Malay Peninsula.

Tree to 24 m tall and 34 cm in diam. *Leaves* (1–)2–4(–7)-jugate, subsessile to shortly petioled; petiole and rachis (0.5–)7–25(–35) cm long. *Leaflets* chartaceous or subcoriaceous, elliptic-oblong or -lanceolate, or lanceolate, (5–)15–20(–30) by (1.5–)3.5–6(–11) cm, the lowest pair usually smaller; glabrous; apex acuminate; base cuneate, obtuse, or rounded, symmetric, rarely the lowest pair obscurely subcordate; midrib slight-



Fig. 46. *Saraca indica* L. Habit and pods. Cultivated in Botanic Garden, Bogor as nr. I-C-19. Photographer unknown.

ly elevated above, prominent beneath; nerves 5–11 per side; petiolules (0–)4–10 mm. *Inflorescences* up to 10(–22) cm wide, slightly pubescent or subglabrous, main branches up to c. 14 cm long, 1.5–5 mm diam.; bracts elliptic or ovate-oblong, 3–8 by 1.5–4.5 mm, caducous or persistent, puberulous and/or minutely ciliate on the margin; bracteoles caducous or persistent during anthesis, erecto-patent to spreading, broadly elliptic or ovate, 3–8 by 1.5–5 mm, glabrous or minutely ciliate on the margin; pedicels (4–) 12–20(–35) mm, the length between bracteoles and flower 7–10(–14) mm. *Flowers* orange yellow, to deep orange or purple, or red, articulated near the base, glabrous. *Hypanthium* 9–12(–16) mm long, 0.5–1.5 mm wide at the throat. *Calyx* lobes ovate,

elliptic, or obovate, 5–12 by 2–8 mm. *Stamens* (5 or) 6–8(–10); filaments 10–35 mm, often puberulous at the basal parts; anthers ellipsoid or oblong, c. 1 mm long; staminodes absent. *Pistil* stipitate, free part of stipe 1.5–4.5 mm, hairy; ovary 4–8 mm long, puberulous, 6–8-ovuled; style 15–35 mm, glabrous; stigma minute, round. *Pods* dark red, oblong, or narrowly oblong-lanceolate, 6–25 by 2–6 cm, 0.5–1.2 cm thick, leathery or woody, 4–6(–8)-seeded, with straight or curved, up to c. 1 cm long beaked apex, and cuneate or obliquely rounded base, valves coiling. *Seeds* ovoid-oblong, sometimes reniform, 4–5 by 2–2.5 cm, and 0.6–1.2 cm thick. — **Fig. 43c, d, 46.**

Distribution — Thailand, Laos, S Vietnam; *Malesia*: Sumatra, Malay Peninsula, Java.

Habitat & Ecology — In forests, often on riverbanks or along streams, up to c. 900 m altitude. Fl. and fr. throughout the year.

Uses — Commonly cultivated as an ornamental [Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1964].

Note — Flowering collections of *Saraca indica* can be recognized by the rather higher number of stamens (usually 6–8) and the bracteoles which are erecto-patent to spreading, not clasping the pedicel, and caducous or persistent during anthesis.

6. *Saraca monadelpha* W.J. de Wilde

Saraca monadelpha W.J. de Wilde, Blumea 27 (1981) 236, f. 1. — Type: *de Vogel 4375* (L), Halmahera.

Tree 15 m tall and 19 cm in diam., or *treelet* 3–6 m tall. *Leaves* (1–)3–6-jugate, sessile or shortly petioled, petiole and rachis (0.3–)4–20 (or more) cm long. *Leaflets* chartaceous, elliptic-oblong to oblong-lanceolate, (5.5–)12–30 by (2–)4–10 cm, the uppermost leaflets generally largest; apex acuminate, acute, or obtuse; base cuneate to shortly attenuate, obtuse, rarely subcordate (for the basal pair), symmetric; glabrous; midrib elevated above, prominent beneath; nerves 7–11 per side; petiolules 2–6 mm. *Inflorescences* up to 12 cm wide, glabrous, branches up to c. 2 cm long; bracts elliptic-ovate, 3–4 mm long, finely puberulous, or glabrous with minutely hairy margin, often caducous; bracteoles elliptic, 4–9 mm long, puberulous, or glabrous with minutely hairy margin, spreading, often caducous, sometimes persistent; pedicels 10–15 mm, the length between bracteoles and flower 2–5 mm. *Flowers* yellow tinged orange, deep yellow, or yellowish pink, articulated near the base, glabrous outside. *Hypanthium* tubular, 18–23 mm long, 4–5 mm wide at the throat, gradually tapering towards the base. *Calyx* lobes broadly elliptic or ovate-elliptic, 8–12 by 6–10 mm, with minutely hairy margin. *Stamens* 4 perfect and 6 tooth-like staminodes united together at their basal parts into a filamental tube of 4–8(–9) by 4–5 mm, the tube sometimes splitting to the base at the side of insertion of the (vestigial) pistil; free parts of filaments 17–20 mm, dilated towards the base, glabrous; anthers broadly ellipsoid, c. 4 mm long; free parts of staminodes (0.5–)1–5 mm. *Pistil* glabrous, stipitate, free part of stipe 2–2.5 mm; ovary 4–5 mm long, 6-ovuled; style (15–)18–22 mm; stigma minute, round. *Pods* (only one immature seen) somewhat spindle-shaped, 24 by 5 cm, c. 1.5 cm thick, apex acuminate with a beak c. 1.5 cm long, base attenuate; rather smooth, with obscure, loosely reticulate veins, valves thinly woody, 5-seeded. *Seeds* (young) broadly ellipsoid, c. 2.5 by 1.5 cm, c. 1.5 cm thick.

Distribution — *Malesia*: Lesser Sunda Islands (Flores). N Moluccas (Halmahera).

Habitat & Ecology — In forest, solitary or scattered, in Halmahera in rather dense or depleted open forest 15–35 m high, with very much or very little undergrowth, on alluvial flat, regularly inundated with heavy rain, with deep clayey soil, near or along a small stream; 20–350 m altitude. Fl. Jan., March, June, Sept., Dec.; fr. Sept.

Note — *Saraca monadelphæ* is characterized by the relatively large fleshy flowers with broad hypanthium (or calyx tube), stamens and staminodes united at their basal parts into a prominent tube, 4–8(–9) by 4–5 mm, large anthers (c. 4 mm long), ovary 6-ovuled, and pod somewhat spindle-shaped.

7. *Saraca thaipingensis* Prain

Saraca thaipingensis Cantley ex Prain, J. As. Soc. Beng. 66, ii (1897) 211, 490; Zuijderh., Blumea 15 (1968) 416, map 1, excl. the Tonkin coll.; Whitmore in Tree Fl. Malaya 1 (1972) 270, f. 2; Verdc., Manual New Guinea Leg., Lac Bot. Bull. 11 (1979) 89; J.E. Vidal in Fl. Thailand 4 (1984) 95, f. 24/8–10. — Syntypes: Cantley 36, Derry 999, Goodenough s.n. & 1875A, King's Coll. (Kunstler) 2249, 2768, 4248, 6088, Wray 2448 (n.v.), Scortechini s.n. (K, L), all Malay Peninsula.

Saraca declinata auct. non (Jack) Miq.: Miq., Fl. Ind. Bat. 1, 1 (1855) 84, 1080, quoad specim.: Koord. & Valetton, Bijdr. Booms. Java 2 (1895) 39; Koord., Atlas 1 (1913) t. 25; Backer & Bakh. f., Fl. Java 1 (1964) 527.

Jonesia declinata auct. non Jack: Binnend., Ann. Jard. Bot. Buitenzorg 1 (1876) 167.

Saraca cauliflora Baker in Hook. f., Fl. Brit. India 2 (1878) 272; Ridley, Fl. Malay Penins. 1 (1922) 641, p.p. — Lectotype (here designated): Griffith 1843 (K holo; L photo); syntypes: Griffith 1843 bis (K, L), Maingay 1488 = 563/1 (K, L), all Malay Peninsula.

Tree to 24 m tall and 38 cm in diam. *Leaves* (4–)7- (or 8-)jugate, subsessile to petioled; petiole and rachis 15–56 cm long. *Leaflets* chartaceous, oblong-lanceolate, 7–32 by 3–9.5 cm; apex acuminate or acute; base cuneate, obtuse, or rounded, symmetric; densely pubescent and sparsely so above when very young, at length often only pubescent on midrib and nerves beneath, otherwise glabrous on both surfaces; midrib usually slightly grooved above, prominent beneath; nerves 6–12 per side; petiolules distinct, (5–) 10–15 mm. *Inflorescences* (8–)15–35(–40) cm wide, glabrous, the main branches 7–18(–23) cm long, 3–10 mm diam.; bracts and bracteoles caducous, sometimes present on very young inflorescences, or bracteoles falling during anthesis; bracts much larger than bracteoles, oblanceolate, 12–35 by 7–22 mm, puberulous or glabrous; bracteoles oblanceolate or oblong-lanceolate, 6–17 by 2–5 mm, almost glabrous; pedicels 7–15 mm, the length between bracteoles and flower 2–5(–8) mm. *Flowers* at first yellow, changing to orange at anthesis, to red later, articulated near the base, glabrous outside. *Hypanthium* (9–)12–26 mm long, 1–1.5 mm wide at the throat. *Calyx* lobes ovate, elliptic, or oblong, 5–10 by 3.5–5 mm. *Stamens* (3 or) 4(to c.7); filaments 8.5–17 mm, glabrous; anthers ellipsoid or oblong, 1–2 mm long; staminode 1, small, or absent. *Pistil* stipitate, free part of stipe 1.5–3 mm, hairy; ovary 4–8 mm long, sparsely hairy or glabrous, (6–)9–12-ovuled; style 10–15 mm; stigma minute, round. *Pods* pink, purple red, narrowly oblong, rather curved, 15–45(–50) by 3.5–10 cm, up to 1.5 cm thick, woody, 6–8-seeded, with usually curved, up to c. 1.5 cm long beaked apex, and cuneate or obliquely rounded base, valves coiling. *Seeds* ellipsoid, 3.6–3.8 by 2–2.4 cm.

Distribution — Burma (southern part), Thailand (Northern and Peninsula); *Malesia*: Malay Peninsula (throughout), Java (common in W and C parts).

Habitat & Ecology — In forest, mostly along streams or rivers, once recorded on limestone, up to 1100 m altitude. Fl. Jan.–Nov.; fr. Jan., Feb., April–July, Sept.

Notes — 1. *Saraca cauliflora* has been placed in the synonymy of *S. declinata* by Zijderhoudt (1968: 419). After having examined the authentic specimens and the original description as mentioned above, I found it is conspecific with *S. thaipingensis*. As described by Baker it has long petiolules (c. 12.5 mm long), ample, dense corymbs, and about 7 stamens, which are all traits characteristic for *S. thaipingensis*.

2. The distinct, long petiolules (often 10–15 mm long), large and caducous bracts (which can be observed on very young inflorescences; 12–35 by 7–22 mm), rather big, robust inflorescences (up to 35, rarely to 40 cm wide), and large pods (up to 45, rarely to 50 cm long, 10 cm wide) are very characteristic for this species.

8. *Saraca tubiflora* W.J. de Wilde

Saraca tubiflora W.J. de Wilde, Blumea 30 (1985) 425, f. 1. — Type: *de Vogel 3308* (L), Sumatra.

Shrub 1 m tall. *Leaves* 2–4-jugate, subsessile, (petiole and) rachis 4–16.5 cm long. *Leaflets* chartaceous, narrowly elliptic, or lanceolate, 13–22 by 4.5–8 cm, apex acuminate; base cuneate to attenuate, rarely obtuse, symmetric; glabrous; midrib elevated above, prominent beneath; nerves 9–11 per side; petiolules 2–4 mm. *Inflorescences* 7–9 cm wide, bracts and bracteoles ovate or triangular, 2–3 mm long, glabrous except the margin minutely fimbriate, persistent, the bracteoles spreading or sometimes erecto-patent and more or less clasping the pedicel; pedicels 10–17 mm, the length between bracteoles and flower 4–6 mm. *Flowers* yellowish red to dark red, articulated at the base, glabrous except minutely fimbriate on the margin of the calyx lobes. *Hypanthium* 55–70 mm long, 4–5 mm wide at the throat. *Calyx* lobes broadly elliptic or ovate, 10–13 by 5–9 mm. *Stamens* 4, rarely 5; staminodes absent; filaments 21–25 mm, dilated and united at the base; anthers not seen. *Pistil* (sterile) (observed in some flowers) sessile (stipe completely united with hypanthium), glabrous; ovary (vestigial) c. 3 mm long, with 9–11 rudimentary ovules; style coiled, 2–3 mm; stigma minute, round. *Pods* not seen.

Distribution — *Malesia*: W Sumatra (Barisan Range). Known only from the type collection.

Habitat & Ecology — In rather undisturbed primary forest (40 m high), with some undergrowth, on hill ridge, deep clayey soil, terrain sloping to steep; 300–500 m altitude. Fl. March.

Notes — 1. This species is characterized by 1) the axillary, rather compact inflorescence which consists of 2 or 3 fasciculate, racemose branches, each about 3 cm long (excluding the flowers) bearing c. 10 flowers, and 2) the large flowers with the longest tube (55–70 mm long) in the genus.

2. De Wilde (l.c.: p. 427) stated that there are 13 flowers available on the type and most of them are completely male. I dissected three flowers; the vestigial ovary in two of them contains 11 rudimentary ovules and the other 9.

DOUBTFUL SPECIES

Jonesia scandens Roxb., Fl. Ind., ed. Carey, 2 (1832) 220; Prain, J. As. Soc. Beng. 66, ii (1897) 217, in note; Zijlderh., Blumea 15 (1968) 425. — Type: *Anonymous s.n.* (extant ?, n.v.), cultivated in the Calcutta Bot. Gard., origin from Sumatra.

The plant was described as “Shrubby scandent, or twining. Leaflets two or three pairs.” The description is too vague to identify the plant.

SENNA

(K. Larsen & Ding Hou)

Senna Mill., Gard. Dict., abr. ed. 4 (1754) under *Senna*; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 105; Mem. N.Y. Bot. Gard. 35 (1982) 64; Watson & Dallwitz, Gen. Leg.—Caesalp. 17 (1983) 17, pro syn. — *Cassia* subg. *Senna* Benth. in Mart., Fl. Bras. 15, 2 (1870) 96; Trans. Linn. Soc. Lond. 27 (1871) 513, 518; de Wit, Webbia 11 (1956) 228. — Type species (Irwin & Barneby 1982): *Senna alexandrina* Mill.

Herbs, shrubs and small *trees*. *Leaves* spirally arranged; extrafloral nectaries present or not. *Inflorescences* racemose, axillary and/or terminal; bracteoles absent. *Sepals* 5. *Petals* 5, subequal. *Androecium* basically 10-merous; filaments of all stamens straight; anther-thecae not ciliate along the sutures. *Pods* either indehiscent or inertly dehiscent through 1 or both sutures, in the last case not coiling or the valves breaking up in one-seeded joints. *Seeds* and funicle variable.

Distribution — A pantropic genus with c. 260 species, c. 1/5 of these in the warmer parts of the Americas. 17 species are treated here, 3 of them indigenous (see note 1 below).

Notes — 1. In our area probably only 3 species are indigenous: *Senna divaricata*, *S. timoriensis* and *S. tora*. It is doubtful whether *S. siamea* is indigenous and the remaining 14 species have all been introduced. Some of them are probably only occasionally met with outside gardens. There are others which we have decided not to include in the key as they have never had any larger distribution as garden plants and are hardly found in any natural vegetation type. A number of taxa, occasionally recorded as in cultivation in *Malesia* have not been included. See the list on page 690.

2. For details on synonymy, literature and typification of the genera *Cassia*, *Chamaecrista* and *Senna*, the reader is referred to the comprehensive revisions by De Wit [Webbia 11 (1956) 197–292] and Irwin & Barneby [Mem. N.Y. Bot. Gard. 35 (1982)].

3. See the note under *Cassia* (p. 556) for the reasons to recognize *Senna* and *Chamaecrista* as genera separate from *Cassia*.

KEY TO THE SPECIES

- 1a. Glands absent from both petioles and rachis 2
- b. Glands present on either petioles or rachis 5

- 2a. Pedicels shorter than sepals; pods winged **1. *S. alata***
- b. Pedicels longer than sepals; pods flat or terete, but never winged **3**
- 3a. Perfect stamens 7; filaments almost equally long; pods terete, up to 23 cm long **13. *S. spectabilis***
- b. Perfect stamens 7, in 2 size classes; pods flat **4**
- 4a. Petiole 2.5–3.5 cm; pods flat, alternating bulging and depressed **11. *S. siamea***
- b. Petiole 1.5–2.5 cm; pods flat, annulate septate **16. *S. timoriensis***
- 5a. Petiolar glands only (N.B.: Lowest pair of leaflets may be caducous) **6**
- b. Glands only present on the rachis between the leaflets **8**
- 6a. Stinking; roughly villose to strigose plant; petiolar gland sessile, oblong, at the basal joint; pods strigose, angulate, 10–14 cm long, c. 5 mm broad **5. *S. hirsuta***
- b. Not stinking; glabrous or almost so; pods glabrous, terete or flat **7**
- 7a. Petiolar gland sessile, globose or ovoid, at the basal joint; pods flattened glabrous, brown with lighter coloured sutures **8. *S. occidentalis***
- b. Petiolar gland narrow, clavate to subulate, above the basal joint; pods terete with lighter coloured sutures **12. *S. sophora***
- 8a. Leaflets 2 pairs, obliquely ovate, very unequal-sided; upper pair much larger than lower one, 4–16.5 by 2–7 cm **4. *S. fruticosa***
- b. Leaflets 3–more pairs, smaller than above **9**
- 9a. Leaflets 18–40 pairs; 1 conical gland between the lowermost pair (often early caducous) **6. *S. multijuga***
- b. Leaflets 3–16 pairs **10**
- 10a. Fertile stamens 10 **11**
- b. Fertile stamens less than 10 **12**
- 11a. Leaves 14–30 cm; leaflets 4–6 pairs; the stipe of the pod 10–20 mm **14. *S. sulfurea***
- b. Leaves 8–18 cm; leaflets 6–10 pairs; the stipe of the pod 5–7 mm **15. *S. surattensis***
- 12a. Leaflets 6–11 pairs; a clavate gland c. 2 mm between the lowest pair and one spindle-shaped gland between the uppermost pair of leaflets . **3. *S. divaricata***
- b. Leaflets 3–5 pairs accrescent; no gland between the uppermost pair **13**
- 13a. Leaflets lanceolate, acute, 4–11 by 2–3.5 cm **10. *S. septemtrionalis***
- b. Leaflets obovate, obtuse, 1.5–4.5 by 1–2.5 cm **14**
- 14a. Leaflets 4 or 5 pairs, 2–2.5 by 1–1.5 cm **9. *S. pendula***
- b. Leaflets 3 pairs **15**
- 15a. Flowers in slender, many-flowered racemes, 5–17 cm long, in upper leaf-axils; pods terete, inflated, 15–20 by 1–1.5 cm **2. *S. bicapsularis***
- b. Flowers in short, axillary, 1–3-flowered racemes, 3–5 mm; pods terete, linear falcate, 10–15 by 0.5 cm **16**
- 16a. A subulate gland between the 2 lower pairs of leaflets; pedicel of flower 0.5–1 cm, of pod up to 1.5 cm; 3 larger anthers abruptly rounded at apex . . . **17. *S. tora***
- b. A subulate gland only between the lowermost pair of leaflets; pedicel of flowers 1–3.5 cm, of pods 2–4.5 cm **7. *S. obtusifolia***



Fig. 47. *Senna alata* (L.) Roxb. Habit. Photograph of a water-colour by unknown artist. Original plate in Leiden; photograph B. Kieft, $\times 0.3$.

1. *Senna alata* (L.) Roxb.

Senna alata (L.) Roxb., Fl. Ind., ed. 2, 2 (1832) 349; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 460. — *Cassia alata* L., Sp. Pl. (1753) 378; Miq., Fl. Ind. Bat. 1, 1 (1855) 93; Corner, Wayside Trees (1940) 388; de Wit, Webbia 11 (1956) 231; Backer & Bakh. f., Fl. Java 1 (1964) 540; Hô, Illus. Fl. S. Vietnam, ed. 2, 1 (1970) 823, f. 2077; Verdc., Manual New Guinea Leg., Lae Bot. Bull.

11 (1979) 38; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 86, pl. 15/1–2; in Fl. Thailand 4 (1984) 108, f. 27/1–2; Rudd in Fl. Ceylon 7 (1991) 68. — Type [Brenan, Fl. Trop. E. Afr., Caesalp. (1967) 64]: A cultivated plant in Herb. Clifford (BM), America.

Shrub 1–2(–5) m; branches thick, pubescent. *Stipules* auriculate-deltoid, 6–10(–15) mm, persistent, brownish red. *Leaves* with 8–20 pairs of leaflets; petiole robust, 2–3 cm; rachis 30–60 cm. *Leaflets* oblong-elliptic, 5–15 by 3–7 cm, obtuse at both ends, glabrous. *Racemes* axillary, dense, robust, many-flowered, 20–50 by 3–4 cm; peduncle stout, 7–14 cm; bracts strobilate, at first enveloping the flowers, broadly ovate, caducous, 2–3 by 1–2 cm; pedicels 5–10 mm. *Sepals* orange-yellow, oblong, unequal, 10–20 by 6–7 mm. *Petals* bright yellow, ovate-orbicular, 16–24 by 10–15 mm, short-clawed. *Stamens*: 2 large with stout filaments, 4 mm long and anthers 12–13 mm opening with apical pores; 4 with filaments 2 mm long and anthers 4–5 mm opening by apical pores; reduced stamens 3 or 4. *Ovary* puberulous, pruinose, sessile, ovules many (up to c. 58); style filiform; stigma small. *Pods* sharply tetragonal, winged, glabrous, black, 10–15 by 1.5–2 cm, wings 4–8 mm. *Seeds* up to c. 50, shining, flattened, quadrangular, 7–8 by 5–8 mm. — **Fig. 47.**

Distribution — According to Irwin & Barneby (1982) native in the Guianas and perhaps in the Orinoco and Amazonian districts of Venezuela; now pantropical. In Java fully established by the middle of the 17th century.

Habitat — Along riverbanks, rain forest edges, lake shores, margins of ponds and ditches, in open forests and wet areas, in orchards and around villages, often in large populations. It occurs from the lowlands up to 2100 m in New Guinea; it is, however, most abundant below 500 m. On Sumbawa between 200–400 m on dry limestone soil in small groves in the low savanna forest.

Uses — Cultivated for medicine and ornament throughout the Malesian area. It is regarded a highly effective remedy against ringworm and various skin diseases; it is also used as a laxative. See K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 740; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 473; Quisumbing, Medic. Pl. Philipp (1951) 377.

Note — According to Verdcourt (1979) it is sometimes becoming a troublesome weed in pastures since the livestock will not eat it and a rapid spread can reduce the area available for grazing.

2. *Senna bicapsularis* (L.) Roxb.

Senna bicapsularis (L.) Roxb., Fl. Ind., ed. 2, 2 (1832) 342; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 399. — *Cassia bicapsularis* L., Sp. Pl. (1753) 376; de Wit, Webbia 11 (1956) 235; Backer & Bakh. f., Fl. Java 1 (1964) 539; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 40; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 99, pl. 29/1–3; in Fl. Thailand 4 (1984) 117, f. 29/1–3; Rudd in Fl. Ceylon 7 (1991) 77. — *Cathartocarpus bicapsularis* (L.) Ham., Prod. Pl. Ind. Occ. (1825) 38. — Lectotype (de Wit 1955): *Herb. Linn.* 528.10 (LINN), India. *Cassia laevigata* auct. non Willd.: Prain, J. As. Soc. Beng. 66, ii (1897) 476; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 744; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 477.

Arborescent *shrub* up to 3 m high, spreading with pendant or sometimes climbing twigs, entirely glabrous except for the young branches which may be thinly pubescent. *Stipules* narrowly lanceolate-subulate, 1–3 mm long, caducous. *Leaves* with 3 pairs of

leaflets; petiole furrowed, slender, 15–25 mm, rachis 10–28 mm, furrowed, glabrous, bearing a clavate to ovoid gland between the lowest pair of leaflets. *Leaflets* obovate to rounded, more or less unequal-sided, 1.5–4 by 1–2.5 cm, base obliquely cuneate, glabrous; petiolules short, glabrous. *Racemes* slender, lax with 6–25 flowers, 5–17 cm long, including the 2–3 cm long peduncle; bracts similar to stipules, slightly smaller, early caducous; pedicels 2–7 mm long including the 2 mm hypanthium. *Sepals* yellowish to reddish brown, glabrous, ovate, broadly rounded, 5–10 mm long. *Petals* yellow, obovate, 11–15 mm long, very short-clawed. *Stamens* 10: 3 lower ones with unequal filaments, 2–10 mm, anthers large, curved, 7 mm, opening with 2 apical pores and longitudinal rims; 4 shorter with 1 mm long filaments and anthers 4–5 mm long; 3 reduced stamens with minute anthers. *Ovary*, stipe and style glabrous; stigma inconspicuous. *Pods* terete, brown, smooth, glabrous, tardily dehiscent, 9–16 cm long, 1–1.5 cm diam. *Seeds* 50–60, olive-green, ovate, flattened, 5–7 mm.

Distribution — Origin neotropic, probably native in the Caribbean area and northern South America. It was early introduced to the Old World tropics. In the Malesian area it has been cultivated and is sometimes naturalized.

Habitat — In *Malesia* in secondary vegetation and plantations, from sea level up to 600 m altitude; in W Malaysia locally run wild.

Uses — Cultivated as an ornamental (cf. K. Heyne, l.c.; Burkill, l.c., under '*Cassia laevigata*' as cited above).

Notes — 1. This species has often been confused with *Senna pendula* (Willd.) Irwin & Barneby (syn. *Cassia coluteoides* Collad.). The most distinctive characters between the two are the short pedicels and the totally glabrous leaves of *S. bicapsularis*.

2. Two varieties are recognized by Irwin & Barneby (l.c.). All the Malesian material examined belongs to var. *bicapsularis*.

3. *Senna divaricata* (Nees & Blume) K. Larsen

Senna divaricata (Nees & Blume) K. Larsen, Nord. J. Bot. 13 (1993) 404. — *Cassia divaricata* Nees & Blume, Syll. Pl. Nov. Ratisb. 1 (1824) 94; Miq., Fl. Ind. Bat. 1, 1 (1885) 97; de Wit, Webbia 11 (1956) 242, f. 2; Backer & Bakh. f., Fl. Java 1 (1964) 539; Rudd in Fl. Ceylon 7 (1991) 83. — Type: *Blume (van Hasselt) s.n.* (L holotype), Java.

Cassia adenantha Zoll. & Moritz in Moritz, Syst. Verz. (1845/46) 2. — Type: *Zollinger 397z* (n.v.), Java.

Cassia bifida Zoll. & Moritz in Zoll., Nat. Geneesk. Arch. Neërl. Ind. 3 (1846) 68 (nomen), 80. — Type: *Zollinger 2854* (L iso), Java.

Shrub up to 5 m high. *Stipules* linear-falcate, 8–10 mm, pubescent. *Leaves* with 6–11 pairs of leaflets; petiole ribbed, 1–2 cm, glabrous to puberulous; rachis 5–8 cm, ribbed, thinly pilose with a 2 mm long, clavate gland between the lowermost pair of leaflets and a spindle-shaped gland between the uppermost pair and often gland-like hairs between the other leaflets. *Leaflets* elliptic-oblong, 1.5–4.5 by 0.5–1.5 cm, upper surface glabrous, lower at first sparsely pilose along the margin, apex rounded, base rounded to acute; petiolules 1–2 mm. *Racemes* axillary, single or two together, 2- or 3-flowered; peduncle glabrous, 1.5–3 cm; bracts boat-shaped, glabrous, 1–2 mm; pedicels 10–22

mm long. *Sepals* ovate-orbicular, glabrous, unequal, 2 outer only 1/3 of the 3 inner, 4–11 mm long. *Petals* yellow (orange brown in dried specimens), broadly ovate, short clawed, glabrous, unequal, 1.5–2.5 cm long. *Stamens* 10: 3 with filaments glabrous, 3 mm long and anthers curved, c. 10 mm with a 2 mm crest, opening by a single apical pore; 7 smaller with very short filaments and anthers slightly smaller, straight and without a pronounced crest, opening by two apical pores. *Ovary* subsessile, sparsely puberulous; style glabrous; stigma inconspicuous. *Pods* strap-shaped on a slender stalk and with a persistent, more or less swollen hypanthium, flat, glabrous, 15–20 by 0.5–0.7 cm. *Seeds* 15–50, flattened, narrowly ovoid, c. 5 mm long.

Distribution — *Malesia*: Java, Philippines (Luzon), Lesser Sunda Islands (Bali).

Habitat — Occurring near water courses or on marshy soil, in secondary forests and in clearings, usually scattered or few together, up to 2700 m.

4. *Senna fruticosa* (Mill.) Irwin & Barneby

Senna fruticosa (Mill.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 121. — *Cassia fruticosa* Mill., Gard. Dict., ed. 8, no. 10 (1768); Corner, Wayside Trees (1940) 388; de Wit, Webbia 11 (1956) 247; Backer & Bakh. f., Fl. Java 1 (1964) 537; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 43; K. & S.S. Larsen in Fl. Thailand 4 (1984) 116. — Type (Irwin & Barneby 1982): '*Cassia tetraphylla* ...' (BM-Herb. Mill.).

Shrub or small *tree* up to 6 m high, all young parts greyish pubescent. *Stipules* linear, 3–4 mm long, early caducous. *Leaves* with 2 pairs of leaflets; petiole slender, puberulous, c. 3 cm long; rachis slender 1–3 cm, bearing an oblong, nipple-shaped gland between the lower pair of leaflets. *Leaflets* membranaceous, obliquely ovate, very unequal-sided, upper pair much larger than the lower one, 4–16 by 2–7 cm; glabrous or glabrescent on upper side, puberulous on lower; apex acute to acuminate, base obliquely cuneate; petiolules c. 3 mm. *Racemes* short, densely flowered, up to 6 cm long including the 2 cm peduncle; bracts narrowly lanceolate to subulate, 2–4 mm, early caducous; pedicels long, slender, puberulous, 2–3 cm. *Sepals* oblong-obovate, yellowish green often mingled with red, puberulous, 7–11 mm. *Petals* yellow, pubescent on both sides, broadly obovate to orbicular, 2–2.5 cm. *Stamens* 7 (or 6): 3 with filaments filiform, 2–4 mm long and anthers glabrous, strongly curved, 6–7 mm, rostrate at apex, opening by an apical pore; 4 (or 3) with filaments dilated distally, 2–3 mm and anthers similar but thicker and 8–9 mm long; upper 3 stamens usually absent. *Ovary* sessile, densely appressed pubescent, style slender, stigma inconspicuous. *Pods* terete, pendulous on a short, stout stipe, 15–25 cm long, 1–1.5 cm in diam., long beaked, slightly annulate. *Seeds* 80–100 embedded in a foetid, black pulp, compressed ovoid, 5–6 mm, dark brown.

Distribution — Indigenous to Mexico and Central America. Cultivated throughout the tropics as ornamental, also in the Malesian area (recorded from Java, Sabah, E Kalimantan, Celebes, New Guinea). It seems rarely to have escaped cultivation and become naturalized. Seed setting is said to be poor.

Habitat — De Wit (1956) reports to have observed a single specimen found in the shade of a sagu-swamp in Celebes.

Uses — Commonly grown as ornamental.

5. *Senna hirsuta* (L.) Irwin & Barneby

Senna hirsuta (L.) Irwin & Barneby, *Phytologia* 44 (1979) 499; *Mem. N.Y. Bot. Gard.* 35 (1982) 425. — *Cassia hirsuta* L., *Sp. Pl.* (1753) 378; Ridley, *Fl. Malay Penins.* 1 (1922) 618; Verdc., *Manual New Guinea Leg.*, *Lae Bot. Bull.* 11 (1979) 45; K. & S.S. Larsen in *Fl. Camb., Laos & Vietnam* 18 (1980) 92, pl. 16/1; in *Fl. Thailand* 4 (1984) 113, f. 28/1; Rudd in *Fl. Ceylon* 7 (1991) 76. — Type (Irwin & Barneby 1982) in *Herb. Clifford* (BM).

Cassia leptocarpa Benth., *Linnaea* 22 (1849) 528; de Wit, *Webbia* 11 (1956) 251. — Lectotype (Irwin & Barneby 1982): *Pohl s.n.* (K), Brazil.

Cassia longisiliqua Blanco, *Fl. Filip.* (1837) 338, non L. f.

Herb up to 2 m high, erect, hairy, stinking; young branches grooved. *Stipules* linear, acute, early caducous. *Leaves* with 3–7 pairs of leaflets; petiole stout, 3–6 cm with a sessile, ovoid-oblong gland near the insertion; rachis 7–10 cm, glandless, produced beyond the upper petiolules into a stout, 2 mm long mucro. *Leaflets* chartaceous, ovate to oblong or obovate, 5–9 by 1.5–3 cm, more or less hairy on both surfaces, often not exactly opposite. *Racemes* axillary or terminal in leafy panicles, c. 1 cm long, 2–5-flowered; bracts subulate, hairy, early caducous; pedicels pubescent, 1.5–2 cm. *Sepals*, 2 outer small, ovate to obovate, rounded, c. 5 mm; 3 inner more or less puberulous, similar but larger, 7–8 mm. *Petals* yellow, obovate, short-clawed, 14–17 mm long. *Stamens* 10: 2 largest with filaments 3–6 mm long, flat, winged, anthers curved, 6–8 mm, beaked, opening by apical pores; 4 similar but only half as long; 1 equal to these but with a narrow anther; staminodes 3. *Ovary* hairy (hirsute or strigose), subsessile; the style short, glabrous; stigma small, subapical. *Pods* long and slender, flat, hairy, more or less straight, 10–20 by 0.5 cm. *Seeds* 50–100, flat, olive, obovoid, 3–4 mm long.

Distribution — Origin tropical South America; long naturalized as a weed in the Old World tropics.

Habitat & Ecology — Scattered mainly around villages at low altitudes. Flowering throughout the year.

Note — De Wit (1956) recognizes two closely related species, *Cassia hirsuta* and *C. leptocarpa*, the first as a weed from Malaysia and Indonesia, the last only from the Philippines. Irwin and Barneby (1982) have combined several species under *Senna hirsuta* which is an extremely variable species in which they recognize 7 varieties, mainly separated on variations in the indumentum and on the shape of the pod; whether it is possible to maintain them shall not be judged here; some of the varieties are based on very few collections. Var. *puberula*, however, of which *C. leptocarpa* is a synonym, seems rather distinct from the typical var. *hirsuta*.

KEY TO THE VARIETIES IN MALESIA

- a. Pods stout, straight, 11–15 by 0.4–0.7 cm. Leaflets hirsute, the hairs straight or ascending, highly lustrous **a. var. *hirsuta***
- b. Pods arched, 15–25 by 0.3–0.5 cm. Leaflets strigulose or pilose, the hairs when loose usually incumbent or incurved, not highly lustrous **b. var. *puberula***

a. var. *hirsuta*

Distribution — This variety is widely spread all over SE Asia. Even if it is not yet collected in the Philippines it undoubtedly occurs there. According to Verdcourt (1979: 45, under *Cassia hirsuta* L.) it is cultivated in Papua New Guinea.

Habitat — Growing along roadsides and in plantations, from lowland up to 700 m altitude.

Uses — Locally used as medicine against eczema and as a green manure. [K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 743].

b. var. *puberula* Irwin & Barneby

Senna hirsuta (L.) Irwin & Barneby var. *puberula* Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 429. — Type: Hassler 3598 (G holo; W), Paraguay.

Cassia longisiliqua Blanco, Fl. Filip. (1837) 338, non L. f. — *Cassia sulcata* Blanco, Fl. Filip., ed. 2 (1845) 236, non DC., substituted for the preceding. — Type (Irwin & Barneby 1982): no type survived, based on description and discussion.

Cassia leptocarpa Benth. var. *hirsuta* Benth., Trans. Linn. Soc. 27 (1871) 531; de Wit, Webbia 11 (1956) 251.

Cassia hirsuta auct. non L.: Chodat & Hassler, Bull. Herb. Boiss. 2, 4 (1904) 692; Merr., Philipp. J. Sc., Bot. 5 (1910) 50.

Note — An introduced weed that early arrived in the Philippines, perhaps via Europe. It was reported as a wayside weed by Blanco already in 1837. It has, as far as we know, not been found elsewhere in SE Asia.

6. *Senna multijuga* (Rich.) Irwin & Barneby

Senna multijuga (Rich.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 492. — *Cassia multijuga* Rich., Act. Soc. Hist. Nat. Paris 1 (1782) 108; de Wit, Webbia 11 (1956) 253; Backer & Bakh. f., Fl. Java 1 (1964) 541. — Type (Irwin & Barneby 1982): *LeBlond s.n.* (P holo).

Tree up to 20(–40) m with a trunk 10–60 cm dbh, young parts generally puberulous. *Stipules* 3–14 mm long, linear or dilated at base, early caducous. *Leaves* with 18–50 pairs of leaflets; petiole 4–30 mm; rachis with a conical gland between the lowermost pair of leaflets (often early caducous). *Leaflets* very shortly stipitate, linear-oblong, 2–4 (–5) by 0.6–0.8 cm, almost glabrous on upper side, lower pubescent particularly towards base; both ends rounded; apex mucronulate. *Flowers* in terminal panicles up to 30 by 40 cm at the end of leafy branches; peduncles 2–4 cm, puberulous; bracts ovate acute, tomentose, c. 2 mm long; pedicels 15–30 mm. *Sepals* when mature greenish yellow, obovate or orbicular, the outer c. 3 mm, the inner c. 5–7 mm. *Petals* yellow, usually glabrous, unequal-sized; the lowermost falcate-spathulate, sessile, 2–3 cm long; the four upper with a 4–6 mm long, slender claw, blade 1–2 cm. *Stamens* 7: 3 with filaments c. 10 mm and anthers 6–7 mm, curved rostrate; 4 with filaments 1–2 mm and with shorter anthers; 3 tiny staminodes. *Ovary* shortly stiped, glabrous; style glabrous; stigma subterminal, inconspicuous. *Pods* flat, on a 2–9 mm(?) long stipe, broadly linear obtuse, dark brown, septate, usually irregularly indented; the sutures prominently marked. *Seeds* 30–60, linear, flattened, glossy, c. 6 mm long.

Distribution — Tropical South America, where several varieties have been recognized; var. *multijuga* has been taken into cultivation and is from the middle of the 19th century found naturalized in S India and a few places in the Malesian region, brought by the Dutch from Surinam to Java. Also planted in S Sumatra and on the Philippines. One collection from Flores does not indicate whether it is a garden plant or naturalized.

Habitat — Growing from sea level to c. 100 m altitude.

7. *Senna obtusifolia* (L.) Irwin & Barneby

Senna obtusifolia (L.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 252. — *Cassia obtusifolia* L., Sp. Pl. (1753) 377; de Wit, Webbia 11 (1956) 254; Brenan, Kew Bull. (1958) 248; Backer & Bakh. f., Fl. Java 1 (1964) 540; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 51; Rudd in Fl. Ceylon 7 (1991) 84. — Lectotype (Brenan 1958) in *Herb. Dillenius* (OXF).

Herb or *undershrub* up to 1 m tall, rarely higher (2.5 m), usually foetid smelling, glabrous or thinly pubescent. *Stipules* setaceous, 10–15 mm, caducous. *Leaves* with 3 pairs of leaflets; petiole 1–4 cm; rachis 2–3 cm, with a subulate, 2 mm long gland between the lowest pair of leaflets. *Leaflets* obovate, shortly petiolulate; membranous, 1–6 by 0.5–4 cm, increasing in size distally, apex rounded and mucronate, base cuneate. *Racemes* axillary, 1- or 2- (or 3-)flowered on a very short peduncle; bracts linear, acute; pedicels 1.5–3.5 cm long, elongating to 2–4.5 cm in fruit. *Sepals* subequal, ovate, 5 by 2–4 mm. *Petals* yellow-orange, unequal, short-clawed, 1–2 cm long. *Stamens* 7, nearly equal, filaments 1.5–2 mm, anthers 3 longer, 4 smaller 1.5–2.5 mm, opening by apical pores, the three larger anthers narrowed shortly below the apex like a bottleneck; staminodes 0–3. *Pods* linear, terete, falcate to straight, 13–23 by 0.4–0.7 cm. *Seeds* 20–30, ovoid-rhomboid, 5–6 by 2–4 mm with very narrow areoles 3–4.5 by 0.3–0.5 mm.

Distribution — Origin uncertain, spread throughout the tropics. It is rare in the Malesian area. It has been collected from Singapore, Java, the Philippines and New Guinea, but probably occurs all over.

Habitat — In the Malesian area only at low altitudes.

Notes — 1. This species is so closely related to *Senna tora* that several authors have regarded them as conspecific, e.g. Bentham. However, it concerns two clearly separated taxa best kept at species level; this was elegantly demonstrated by Brenan. The strong foetid smell of *S. tora* is usually absent from *S. obtusifolia* which is also recognizable by the much longer pedicels and by the differences in the areole. The singular foliar gland is mostly a good character; it is, however, pointed out by several authors that particularly in Africa a 'race' with two foliar glands has been introduced and spread. Generally *S. obtusifolia* is readily recognizable even in the field by the longer pedicels.

2. Concerning the typification that of Brenan (l.c.) clearly overrules that of De Wit (l.c.).

8. *Senna occidentalis* (L.) Link

Senna occidentalis (L.) Link, Handb. 2 (1831) 140; Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 436. — *Cassia occidentalis* L., Sp. Pl. (1753) 377; Miq., Fl. Ind. Bat. 1, 1 (1855) 94; Prain, J. As.



Fig. 48. *Senna occidentalis* (L.) Link. Habit. Photograph of a water-colour by unknown artist. Original plate in Leiden; photograph B. Kieft, $\times 0.37$.

Soc. Beng. 66, ii (1896) 160, 474, 476; Ridley, Fl. Malay Penins. 1 (1922) 618; de Wit, Webbia 11 (1956) 256; Backer & Bakh. f., Fl. Java 1 (1964) 538; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 93, pl. 16/2–4; in Fl. Thailand 4 (1984) 113, f. 28/2–4. — Type (de Wit 1955): *Herb. Linn.* 528.13 (LINN).

Cassia occidentalis L. var. (β) *aristata* Collad., Hist. Nat. Méd. Casses (1816) 108; Hassk., Pl. Jav. Rar. (1848) 405. — Type (Irwin & Barneby 1982): *Badier s.n.* (not found at G or P), St. Domingo and Guadeloupe.

Erect, subglabrous, foetid *herb* or *undershrub* 1.5–2 m tall, usually annual (in any case in seasonal climates). *Stipules* triangular to linear-acute, more or less falcate, 1–2 cm long. *Leaves* with 3–5(–6) pairs of leaflets; petiole 3–4 cm long with a relatively large, ovoid gland just above the petiole joint; rachis 8–12 cm. *Leaflets* membranous, ovate-oblong, more or less unequal-sided, 4–10 by 2–3 cm, apex acuminate, base rounded; upper surface glabrous, lower glabrous or more or less pruinose to finely puberulous; petiolule c. 2 mm. *Racemes* short peduncled (2–4 mm), 2–4-flowered, mainly terminal; bracts linear-acute, caducous; pedicels 5–10 mm. *Sepals* unequal, outer ones orbicular, c. 6 mm diam., inner ones ovate, larger. *Petals* yellow with violet veins, 2 outer slightly larger, 1–2 by 1.5 cm, short-clawed. *Stamens*: 2 long with filaments 5–6 mm long, anthers 5–7 mm long, opening by apical pores; 4 with filaments 2–3 mm and anthers 5–6 mm opening the same way; reduced stamens with 3–4 mm long filaments and tiny anthers. *Ovary* tomentose; style glabrous; stigma lateral, small. *Pods* linear, flattened, glabrous or nearly so, brown with pale margins, 10–12 by 1 cm. *Seeds* 30–40, flat, orbicular, 3–4 mm diam. — **Fig. 48.**

Distribution — Of South American origin, now one of the most widespread of the weedy *Sennas* found throughout the warmer parts of the world. In the Malesian area an immigrant of long standing.

Habitat & Ecology — In waste places from sea level up to 1200 m, often near and in villages. It flowers throughout the year.

Uses — As the English name 'Nigger coffee' indicates the seeds are widely used as a substitute for coffee; this use is also reported from Borneo. From other areas also medicinal uses are reported. See K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 745; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 478; Quisumbing, Medic. Pl. Philipp. (1951) 382.

9. *Senna pendula* (Willd.) Irwin & Barneby

Senna pendula (Willd.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 378. — *Cassia pendula* Humb. & Bonpl. ex Willd., Enum. (1809) 440. — Type: *Humboldt & Bonpland s.n.* (B-Willd. 7948), Colombia.

Cassia coluteoides Collad., Hist. Nat. Méd. Casses (1816) 102; de Wit, Webbia 11 (1956) 239. — Lectotype (Irwin & Barneby 1982): specimen of cult. pl. in *Herb. Bouchet* (MPU).

Cassia reinwardtii Hassk., Tijds. Nat. Gesch. Physiol. 5 (1838/39) 269; Ann. Sci. Nat. Hist. II, 14 (1840) 58. — Type (de Wit 1956): *Herb. Reinwardt* (L sh. 903.113–467 holo), Java cult.

Cassia indecora Humb., Bonpl. & Kunth, Nov. Gen. Sp. 6 (1823) 271; Hassk., Pl. Jav. Rar. (1848) 403. — Type (Irwin & Barneby 1982): *Humboldt, Bonpland & Kunth 1177* (P holo; B), Venezuela.

Shrub 1–3(–4) m high, indumentum varying from almost glabrous to more or less densely pubescent. *Stipules* linear lanceolate, 2–10 mm long, very early caducous. *Leaves*

with 3–6 pairs of leaflets; petiole 1.5–4 cm, sulcate; rachis 3–6 cm with a subsessile, ovoid to obovoid gland between the lowest pair of leaflets, more rarely between the second pair or between all but the distal. *Leaflets* obovate to oblanceolate, unequal-sided, 2–5 by 1–3 cm; upper surface glabrous, lower more or less sparsely pubescent; base unequal-sided, more or less cuneate; petiolules c. 1 mm, pubescent. *Racemes* axillary, usually few-flowered, 3–10 cm long including the 3 cm long peduncle; bracts similar to the stipules; pedicels 15–30 mm long. *Sepals* glabrous, ovate to oblong, broadly rounded, c. 10 mm long. *Petals* golden to orange-yellow, obovate, 15–25 mm long, subsessile. *Stamens*: 2 long with filaments 11–12 mm, anthers curved, c. 10 mm, opening by apical pores; 1 shorter with filament 4–5 mm and a similar but narrower anther; 4 short ones with filaments 1–2 mm and straight anthers 4–6 mm; 3 staminodes with 1–2 mm filament and anthers transformed to a trapeziform blade; all yellow. *Ovary* sessile, more or less sparsely puberulous; style filiform, incurved or hooked distally; stigma inconspicuous. *Pods* pendulous, terete, short-stiped (sterile at base and looking long-stiped), stipe 2–5 mm, usually glabrous, 8–15 cm long, 5 mm diam. *Seeds* dark brown, flattened, ovoid, 4–6 mm, separated by septa.

Distribution — Tropical and subtropical South America; elsewhere occurring as a weed; very rare in *Malesia*.

Note — This is an extremely variable species in which Irwin & Barneby recognize 19 varieties. However, most of these are not clearly separated. The almost glabrous plants collected in Java are probably best placed in var. *glabrata* (Vogel) Irwin & Barneby, while the others may approach var. *advena* (Vogel) Irwin & Barneby.

10. *Senna septemtrionalis* (Viv.) Irwin & Barneby

Senna septemtrionalis (Viv.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 365. — *Cassia septemtrionalis* Viv., Elench. Pl. Hort. Bot. J. Car. Dinegro (1802) 14; Rudd in Fl. Ceylon 7 (1991) 78. — Type: not known, ex descr.

Cassia laevigata Willd., Enum. Hort. Berol. (1809) 44; Corner, Wayside Trees (1940) 389. — Type: *Herb. Willdenow* 7952 (B), cult.

Cassia quadrangularis Zoll. & Moritz in Moritz, Syst. Verz. (1845/46) 2; Miq., Fl. Ind. Bat. 1, 1 (1855) 91. — Type: *Zollinger 1670* (G holotype), Java.

Cassia floribunda auct. non Cav.: de Wit, Webbia 11 (1956) 245; Backer & Bakh. f., Fl. Java 1 (1964) 539; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 43.

Evergreen *shrub* or small *tree* up to 4 m, young branches smooth, green. *Stipules* narrowly lanceolate, acuminate, 3–7 mm long, early caducous. *Leaves* with 3–4(–5) pairs of leaflets; petiole 1.5–5 cm long, glabrous, grooved; rachis 6–12 cm long, bearing a clavate or conical gland between all except the upper pair of leaflets. *Leaflets* ovate to ovate-elliptic, 4–11 by 1.5–3.5 cm, glabrous on both surfaces; apex acute to acuminate, base rounded to cuneate; petiolules c. 2 mm. *Racemes* axillary or terminal, 4–10-flowered, 5–10 cm including the 2.5–4 cm long peduncle; bracts linear-lanceolate, 2–5 mm, caducous; pedicels 1.5–2.5 cm long, glabrous. *Sepals* yellowish green, ovate-elliptic, unequal, 4–10 mm. *Petals* bright yellow, ovate orbicular, shortly clawed, glabrous, 1–1.5(–2) cm. *Stamens*: 2 long with filaments dilated, ribbon-like, 8–11 mm with an-

thers 8 mm, curved, opening by an apical pore; one with similar anther but with filament 4 mm; 4 with filaments 2 mm long and anthers 4–5 mm; 3 staminodes with anthers flat, suborbicular, non-functioning. *Ovary* glabrous; style linear; stigma inconspicuous. *Pods* terete, slightly subquadrangular when fully mature, tardily dehiscent, 6–10 cm, c. 1 cm diam. *Seeds* 50–70, obovoid, olive, glossy, flat, 5–6 mm.

Distribution — Origin uncertain but neotropic, apparently native to Mexico and Central America. Since pre-Columbian times cultivated for medical purposes and widely spread; long established in the Old World tropics including *Malesia*: Sumatra, the Malay Peninsula, Java, and New Guinea.

Habitat — In the Malesian area escaped from cultivation and occurring as a weed up to 2500 m altitude, along waysides and ditches, also in grasslands and young secondary forests.

Uses — Cultivated as ornamental and as a hedge plant.

11. *Senna siamea* (Lam.) Irwin & Barneby

Senna siamea (Lam.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 98. — *Cassia siamea* Lam., Encycl. Méth. Bot. 1 (1785) 648; Prain, J. As. Soc. Beng. 66, ii (1897) 163; Merr., Philipp. J. Sc., Bot. 5 (1910) 51; Ridley, Fl. Malay Penins. 1 (1922) 617; Corner, Wayside Trees (1940) 390; de Wit, Webbia 11 (1956) 263; Backer & Bakh. f., Fl. Java 1 (1964) 541; Hô, Illus. Fl. S. Vietnam, ed. 2, 1 (1970) 824, f. 2081; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 52; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 87, pl. 15/3–4; in Fl. Thailand 4 (1984) 110, f. 27/3–4; Rudd in Fl. Ceylon 7 (1991) 71. — Type (Irwin & Barneby 1982): *Commerson s.n.* (P). *Cassia florida* Vahl, Symb. Bot. 3 (1794) 57; Miq., Fl. Ind. Bat. 1, 1 (1855) 98. — Type (Irwin & Barneby 1982): from India, in C.

Cassia sumatrana Roxb. ex Hornem., Suppl. Hort. Bot. Hafn. (1819) 135; DC., Prodr. 2 (1825) 506. — *Senna sumatrana* (Roxb. ex Hornem.) Roxb., Fl. Ind., ed. 2, 2 (1832) 347. — Type: *Roxburgh s.n.* (C), India.

Cassia arayatensis auct. non Llanos: Naves in Blanco, Fl. Filip., ed. 3 (1877–83) t. 426; Merr., Sp. Blanc. (1918) 173.

Tree up to c. 15 m; young branches pubescent, finely striate. *Stipules* tiny, subulate, caducous. *Leaves* with 7–10(–15) pairs of leaflets; petiole 2–3 cm; rachis 10–25 cm. *Leaflets* ovate-oblong, 3–7 by 1–2 cm; rounded or emarginate, at apex with a short mucro, rounded at base; glabrous on upper surface, finely pubescent below. *Inflorescence* large, terminal panicles on a robust, 5–7 cm long peduncle; bracts obovate, long acuminate, c. 5 mm; pedicels 2–3 cm, velutinous. *Sepals* orbicular, unequal, velutinous outside, the two outer c. 5 mm, the inner up to 9 mm. *Petals* yellow, oblong-obovate with a short claw, 1.5–2 cm. *Stamens*: 2 with filaments c. 10 mm and anthers 6–7 mm with apical dehiscence; 4–5 with filaments 2–3 mm and anthers 5–6 mm; 2–3 staminodes c. 3 mm. *Ovary* densely velutinous; style glabrous; stigma inconspicuous. *Pods* flattened, alternately expressed and depressed over the seeds giving a 'wavy' surface; sutures thick, rib-like, 20–30 by 1–1.5 cm. *Seeds* 20–30, ovate, light brown 20–25 by 5–6 mm.

Distribution — Indigenous to Burma, Thailand and probably Cambodia, Laos and Vietnam. It is widely planted throughout the tropics.

Habitat & Ecology — In various types of forests at low altitudes. Flowering throughout the year.

Uses — Planted as ornamental in parks, gardens and frequently used as wayside tree up to 1000 m altitude. As a rapid growing species it is also appreciated for use as shade trees and windbreak in e.g. coffee plantations. It is sometimes running wild but hardly occurs as truly naturalized. Locally used for medicinal purposes. See K. Heyne, Nutt. Pl. Indon., ed. 3 (1950), 747; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 480.

12. *Senna sophora* (L.) Roxb.

Senna sophora (L.) Roxb., Fl. Ind., ed. 2, 2 (1832) 347 ('*sophora*'); Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 440. — *Cassia sophora* L., Sp. Pl. (1753) 379; Miq., Fl. Ind. Bat. 1, 1 (1855) 92; Prain, J. As. Soc. Beng. 66, ii (1897) 161; Merr., Philipp. J. Sc., Bot. 5 (1910) 50; de Wit, Webbia 11 (1956) 265; Backer & Bakh. f., Fl. Java 1 (1964) 538; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 54; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 94, pl. 16/5–8; in Fl. Thailand 4 (1984) 115, f. 28/5–8; Rudd in Fl. Ceylon 7 (1991) 74. — Type (Rudd 1991): *Herb. Hermann* 4: 79 (BM), Sri Lanka.

Erect, almost glabrous *shrub*, 1–2(–3) m high. *Stipules* ovate, more or less glabrous, c. 5 mm long, caducous. *Leaves* with 4–10 pairs of leaflets; petiole 3–5 cm long with a thin, subulate or narrowly clavate gland, 5–10 mm above the petiole joint. *Leaflets* lanceolate, on a slender, 2 mm long petiolule, apex acute, base rounded, 2–5(–8) by 1–2 cm, the upper leaflets largest. *Inflorescences* axillary, few-flowered corymbs; peduncle 1–2 cm; bracts ovate, 5 mm long; pedicels 1–1.5 cm. *Sepals* ovate-rounded, 5 mm long. *Petals* yellow, obovate, 10–14 by 6–8 mm, short-clawed. *Stamens*: 2 with filaments 5–7 mm long, anthers 5–6 mm long opening by apical pores; 4 shorter with filaments 2 mm and anthers 5 mm, opening the same way; staminodes 3–4, c. 2 mm. *Ovary* finely pubescent; style thin, glabrous; stigma slightly dilated, strongly incurved. *Pods* erect, straight or nearly so, cylindric (swollen) or linear-ellipsoid, 6–10 by 0.5–1 cm, sutures not prominent. *Seeds* 30–40 ovoid, compressed, 3–4 mm.

Distribution — Origin neotropic, now found throughout the tropics. It seems not to be equally common in all parts of *Malesia*; it is evidently not so frequent on the Malay Peninsula and in the Philippines, but this may be due to lack of collections.

Habitat — Roadsides, old fields, ditches, waste places and around and in villages, usually at lower altitudes.

Uses — Locally used for medicinal purposes. See K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 747; Quisumbing, Medic. Pl. Philipp. (1951) 384.

Note — Often confused with *Senna occidentalis*. The narrower leaves and the narrow, thin, petiolar gland separate the two species.

13. *Senna spectabilis* (DC.) Irwin & Barneby

Senna spectabilis (DC.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 600. — *Cassia spectabilis* DC., Cat. Hort. Monsp. (1813) 90; Corner, Wayside Trees, ed. 2 (1952) 727; de Wit, Webbia 11 (1956) 267; K. & S.S. Larsen in Fl. Thailand 4 (1984) 110, f. 29/6–7; Rudd in Fl. Ceylon 7 (1991) 69. — Type in *Herb. de Candolle* (G).

Small *tree* up to 7(–10) m tall with long, spreading leafy branches; young parts softly pubescent. *Stipules* linear falcate, early caducous, c. 1 cm long. *Leaves* with 10–15(–19) pairs of leaflets; petiole 3–4 cm; rachis 20–10(–35) cm. *Leaflets* with short petiolule, narrowly elliptic, 3–7 by 1–2 cm (the lowermost pair usually much smaller and early caducous); base rounded, apex acute, mucronate; upper surface glabrous, lower finally appressed pubescent. *Inflorescence* large terminal, leafy panicles, 20–30(–90) cm; bracts ovate, 4–5 mm long, caducous; pedicels 2–3 mm, velutinous. *Sepals* orange-yellow, unequal, ovate to suborbicular; 2 outer pubescent, 3 inner glabrous, larger, 5–7 mm long. *Petals* yellow, spatulate, unequal, broadly to narrowly obovate, 2–3.5 cm with a distinct, short claw. *Stamens*: 7 large functioning ones with filaments 2–3 cm long, anthers opening by apical pores and a slit; staminodes 3. *Ovary* glabrous, recurved; style and stigma inconspicuous. *Pods* pendulous, more or less terete or slightly compressed, glabrous, glossy, black, annulate-septate, 18–25 by c. 1 cm. *Seeds* 50–70, suborbicular, c. 5 mm diam.; septae papery.

Distribution — Native of tropical America. A widely grown ornamental all over *Malaysia*.

Note — Irwin & Barneby (1982: 604) have characterized this species as one of the “handsomest ornamental *Sennas* recommended for rapid growth.” The flowers are fragrant and, in fully grown plants, the large, thyrsiform panicles may rise a metre above the crown.

14. *Senna sulfurea* (Collad.) Irwin & Barneby

Senna sulfurea (Collad.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 78. — *Cassia sulfurea* Collad., Hist. Nat. Méd. Casses (1816) 84. — Type: (Irwin & Barneby 1982: No type found ... but the plant in G-DC labelled “*Cassia sulfurea* Ile de France ou de Bourbon, Muséum de Paris, 1821” is considered authentic).

Cassia glauca Lam., Encycl. Méth. Bot. 1 (1785) 647, non *Senna glauca* Roxb. 1832; Ridley, Fl. Malay Penins. 1 (1922) 616. — *Cassia surattensis* subsp. *glauca* (Lam.) K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 102, pl. 17/4–5; in Fl. Thailand 4 (1984) 120, f. 29/4–5.

Cassia surattensis auct. non Burm. f.: de Wit, Webbia 11 (1956) 269; Backer & Bakh. f., Fl. Java 1 (1964) 538; Verde., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 55.

Cassia surattensis f. *ferox* de Wit, Webbia 11 (1956) 272. — Type: *Neth. Ind. For. Serv. bb 21434* (= de Voogd 2850) (BO), Flores.

Large *shrub* or small *tree*, 2–6 m tall; young parts strigulose later glabrous. *Stipules* linear falcate, 6–15 mm long. *Leaves* with 4–6 pairs of leaflets; petiole 3–5.6 cm; rachis 5–15 cm with a clavate gland, 1–2 mm long, between the 2 or 3 (or 4) lower pairs of leaflets. *Leaflets* with short petiolule, broadly elliptic-lanceolate, 5–10 by 2–4 cm, with acute apex; upper surface glabrous, lower sparsely pubescent. *Inflorescences* lateral racemes with peduncles 3–10 cm, axis 1–6 cm; bracts ovate acute, 3–8 mm long, finally reflexed; pedicels 1–3 cm. *Sepals* green to reddish brown, 2 outer suborbicular c. 3 mm, the 3 inner obovate, increasing to 6–9 mm in length. *Petals* bright yellow (drying orange or pinkish brown), ovate-obovate, 1.5–2 cm long, with a narrow claw 1–1.5 cm long. *Stamens* 10 fertile with thick, short filaments, 1–4 mm; anthers subequal 5–7 mm long, opening apically by short slits. *Ovary* strigulose; style glabrous, filiform; stigma incon-

spicuous. *Pods* flat, glossy, 12–17 by 1.5–1.8 cm with papery valves. *Seeds* 20–30, oblong-elliptic, c. 7 by 4 mm.

Distribution — The species is native to India and Burma. Now also naturalized in the Neotropics.

Habitat — This species seems to have a wide ecological amplitude. It is naturalized widely in the Indo-Malesian region in open, disturbed forests, waste places and around villages.

Uses — Cultivated as ornamental throughout SE Asia from remote times, also grown as a shade plant.

Notes — 1. This species and *Senna surattensis* belong to sect. *Psilorhagma* (Vogel) Irwin & Barneby (l.c.: 77); a full account of the intricate nomenclature of these two taxa is given there.

2. We do not maintain forma *ferox* de Wit, known only from two collections. It may be an ecotypical deviating form as suggested by the author.

15. *Senna surattensis* (Burm. f.) Irwin & Barneby

Senna surattensis (Burm. f.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 81, f. 10 (p.p.). — *Cassia surattensis* Burm. f., Fl. Ind. (1768) 97; de Wit, Webbia 11 (1956) 269. — *Cassia surattensis* Burm. f. subsp. *surattensis*: K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 99; in Fl. Thailand 4 (1984) 119. — Type in *Herb. Garcin* (G).

Cassia suffruticosa Roth, Sp. Pl. (1821) 213. — *Cassia glauca* Lam. var. *suffruticosa* (Roth) Baker in Hook. f., Fl. Brit. India 2 (1878) 265. — *Cassia surattensis* Burm. f. subsp. *suffruticosa* (Roth) K. & S.S. Larsen, Nat. Hist. Bull. Siam Soc. 25 (1974) 205. — Type (Irwin & Barneby 1982): König (?), not seen, from India.

Shrub or small **tree** up to 7 m tall; young branches puberulous. *Stipules* linear falcate, 5–10 mm long, subpersistent. *Leaves* with 6–9 pairs of leaflets; petioles 1.5–3 cm; rachis up to 15 cm with a clavate, 1–2 mm long gland between the 2 or 3 lower pairs of leaflets. *Leaflets* with short petiolule, ovate to ovate-oblong, 2.5–4 by 1–1.7 cm; upper surface glabrous, lower sparsely pubescent; apex rounded, more or less slightly emarginate, base rounded, rarely cuneate. *Racemes* from the upper leaf axils, 3–6 cm long, 10–15-flowered; peduncle 2.5–5 cm; bracts ovate acute, 4–5 mm long, finally reflexed; pedicels 1–2 cm. *Sepals*: 2 outer more or less orbicular, c. 3 mm long; 3 inner obovate up to 7 mm long. *Petals* yellow, subequal, ovate-obovate, 1.5–2 cm long with a 1–1.5 mm long, narrow claw. *Stamens* 10 fertile, with short, thick filaments, 1–4 mm long; anthers subequal, 5–7 mm long, opening by apical slits. *Ovary* puberulous; style glabrous; stigma indistinct. *Pods* flat, glabrous with papery valves, 7–10 by 1–1.5 cm. *Seeds* 15–25, glossy flattened, 8 by 4 mm.

Distribution — Origin uncertain. Irwin & Barneby (l.c.) quote Bentham who thought it native of N Australia, while later authors regard it as introduced there. It might come from the same area in India as the closely related *Senna sulfurea*, but it seems mainly, also here, to be a garden plant. It is also widely cultivated in the Neotropics.

Habitat — As *Senna sulfurea*.

16. *Senna timoriensis* (DC.) Irwin & Barneby

Senna timoriensis (DC.) Irwin & Barneby, Mem. N.Y. Bot. Gard. 35 (1982) 98. — *Cassia timoriensis* DC., Prodr. 2 (1825) 499; Decne., Herb. Timor. Descr. (1835) 17; Miq., Fl. Ind. Bat. 1, 1 (1855) 99; Ridley, Fl. Malay Penins. 1 (1922) 617; Corner, Wayside Trees (1940) 390; de Wit, Webbia 11 (1956) 273; Backer & Bakh. f., Fl. Java 1 (1964) 541; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 88, pl. 1/5; in Fl. Thailand 4 (1984) 111, f. 27/5; Rudd in Fl. Ceylon 7 (1991) 72. — *Anonymus s.n.* (P), Timor.

Cassia xanthocoma Miq., Analecta 1 (1850) 10. — *Cassia timoriensis* var. *βxanthocoma* (Miq.) Miq., Fl. Ind. Bat. 1, 1 (1855) 99; Prain, J. As. Soc. Beng. 66, ii (1897) 163. — *Cassia timoriensis* f. *xanthocoma* (Miq.) de Wit, Webbia 11 (1956) 274. — Type (de Wit, 1956): in L, sh. 908.114-28, Borneo.

Cassia arayatis Llanos, Fragn. (1851) 71; Fern.-Vill. & Naves in Blanco, Fl. Filip., ed. 3 (1880) 55; Merr., Sp. Blanc. (1918) 173. — Type: not known, based on description.

Cassia montana auct. non B. Heyne: Naves in Blanco, Fl. Filip., ed. 3 (1877–83) t. 452; Merr., Sp. Blanc. (1918) 173.

Small tree, rarely above 10 m tall; young branches and leaves varying in hairiness from subglabrous to velutinous in yellow to golden colours. *Stipules* auriculate, 1.5–2 cm. *Leaves* with 10–20 pairs of leaflets; petiole 1–2 cm; rachis 20–30 cm, pubescent. *Leaflets* with a short petiolule, oblong, 2–6 by 1–1.5 cm with rounded base and sub-acute to mucronate apex, from nearly glabrous to yellowish pubescent on both sides. *Inflorescences* axillary, dense racemes, 10–30 cm long; axis more or less glabrous to yellowish pubescent; bracts caducous, ovate, acute, up to 20 by 15 mm; pedicels 1–3 cm, pubescent. *Sepals* unequal, oblong-ovate with rounded apex, 7–15 mm long, yellowish pubescent outside. *Petals* yellow, obovate, short-clawed, 15–20 by 10–15 mm. *Stamens*: 2 largest with filaments 2–4 mm and anthers 8–10 mm long opening by apical pores; 5 somewhat smaller opening in the same way; staminodes 3, c. 2 mm. *Ovary* more or less glabrous; style glabrous; stigma inconspicuous. *Pods* flat, glabrous, dehiscent, 8–16 by 1–1.5 cm. *Seeds* 10–30, elliptic, glossy, flattened, 7 by 5 mm.

Distribution — From Sri Lanka throughout SE Asia to N Australia.

Habitat & Ecology — Seems to prefer calcareous soil. It is always growing in light-open forests up to 1100 m, e.g. in the deciduous dipterocarp forests. It is often seen as a pioneer species in forest margins towards clearings. It flowers throughout the year.

Uses — The wood is highly resistant to insect attacks and frequently used for various construction purposes. Young leaves are edible. The pods are locally used in medical treatments of e.g. worms. It is also planted as a wayside tree and in Timor it is used in mixed afforestations for soil protecting purposes. See K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 748; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 481.

17. *Senna tora* (L.) Roxb.

Senna tora (L.) Roxb., Fl. Ind., ed. 2, 2 (1832) 340. — *Cassia tora* L., Sp. Pl. (1753) 376; Prain, J. As. Soc. Beng. 66, ii (1897) 158, 475; de Wit, Webbia 11 (1956) 276; Brenan, Kew Bull. (1958) 248; Backer & Bakh. f., Fl. Java 1 (1964) 539; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 56; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 96, pl. 16/9–11; in Fl. Thailand 4 (1984) 117, f. 28/9–11; Rudd in Fl. Ceylon 7 (1991) 83. — Type (de Wit 1956): *Herb. Linn.* 528.9 (LINN), India.

Cassia borneensis Miq., Anal. Bot. Ind. 1 (1850) 9; Merr., Bibl. Enum. Born. (1921) 300. — *Cassia tora* τ *borneensis* Miq., Fl. Ind. Bat. 1, 1 (1855) 95. — Type: in L sh. 908.112-496 (L).

Herb or undershrub up to 1 m high, foetid smelling, almost glabrous. *Stipules* setaceous, 10–15 mm, caducous. *Leaves* with 3 pairs of leaflets; petiole 1–4 cm; rachis 2–3 cm with a subulate, 2 mm long gland between the two lower pairs of leaflets. *Leaflets* shortly petiolulate, membranous, obovate, 2–5 by 1.5–2.5 cm, increasing in size distally; apex broadly rounded, base cuneate to rounded. *Racemes* axillary, short, 1- or 2- (or 3-)flowered; bracts linear, acute; pedicels 5–10 mm, enlarging in fruit up to 15 mm. *Sepals* subequal, ovate, 5 by 2–4 mm. *Petals* yellow, unequal, obovate, short-clawed with rounded apex, up to 10 by 6 mm. *Stamens*: 7 nearly equal, filaments 1.5–2 mm; anthers 3 larger, 4 smaller, 1.5–2.5 mm, opening by apical pores, the 3 larger abruptly rounded at apex; staminodes absent. *Ovary* densely pubescent; style glabrous; stigma truncate. *Pods* linear, terete, more or less falcate, 10–15 by 0.5 cm. *Seeds* 20–30, glossy, rhomboidal, 5 by 3 mm with an areole 1.5–2 mm wide covering much of the seed surface.

Distribution — Origin uncertain, but strictly palaeotropic in its occurrence.

Habitat — In the Malesian area it is common throughout at lower altitudes.

Uses — Young leaves are eaten locally, e.g. in Sumatra; in Timor it is believed to improve the soil. In India the seeds are roasted as a substitute for coffee; for further information on local use as medicinal plant, see K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 748; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 481; Quisumbing, Medic. Pl. Philipp. (1951) 385.

Note — The present species is very closely related to *Senna obtusifolia* and is habitually similar to that species. *Senna obtusifolia* is obviously rare and is often confused with *S. tora*. See also note 1 under *S. obtusifolia*.

EXCLUDED SPECIES

A number of species have occasionally been recorded as in cultivation in *Malesia*. They have not been included in the present treatment. See also under *Cassia*.

Senna auriculata (L.) Roxb. (basonym *Cassia auriculata* L.) is a species native to India, Burma and Sri Lanka; formerly it was cultivated in Java and W Malaysia where the bark was used for tanning. According to literature it did not seed readily and is difficult to propagate. It is probably no more in use. See Maman Rahmansyah in Lemmens & Wulijarni-Soetjipto (eds.), Pl. Res. SE Asia (PROSEA Handb.) 3, Dye and tannin-producing plants (1991) 62–63 sub *Cassia auriculata*. There is one specimen in L collected from a garden in the Philippines.

Senna didymobotrya (Fresen.) Irwin & Barneby (basonym *Cassia didymobotrya* Fresen.) from E Africa, which is very rarely cultivated in gardens. There is one collection in L collected from New Guinea.

Senna galegifolia (L.) Barneby & Lourt. [basionym *Cassia galegifolia* L.; syn. *Cassia biflora* L., nom. ambig.; *C. pallida* Vahl; *Senna pallida* (Vahl) Irwin & Barneby] is a South American species very rarely grown in gardens. It has been reported as a garden plant in W Malaysia. There is no material found in L.

Senna multiglandulosa (Jacq.) Irwin & Barneby (syn. *Cassia tomentosa* L. f.; *C. multiglandulosa* Jacq.) is indigenous to tropical America. It is cultivated in Malesia as ornamental, but no collection was seen from this region.

Senna splendida (Vogel) Irwin & Barneby (basionym *Cassia splendida* Vogel) is native to South America. It is very rarely grown in gardens. There is no material collected from Malesia in L.

SINDORA

(Ding Hou)

Sindora Miq., Fl. Ind. Bat., Suppl. (1861) 287; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 5; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 53; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 132. — Type species: *Sindora sumatrana* Miq.

Echinocalyx Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 584 & ditto (1867) 1003. — No species described.

Trees. *Stipules* foliaceous, free, rarely connate at the lower half. *Leaves* alternate, paripinnate, 2–10-jugate. *Leaflets* opposite, coriaceous, often with scattered pellucid dots, shortly petiolulate; midrib usually slightly grooved above, prominent below, often ending in a \pm developed, terminal gland; nerves many, usually more than 20 per side, obscure or faint above, visible or distinct beneath, leaving the midrib at an angle of about 60° or more and forming a thickened nerve close to the margin; veins finely, very closely reticulate (by examining, e.g. with a hand-lens) on both surfaces, petioled. *Inflorescences* solitary or gregarious, paniculate or racemose; bracts and bracteoles small, often caducous or sometimes present at anthesis. *Flowers* bisexual, zygomorphic, shortly pedicelled or subsessile. *Hypanthium* very short. *Calyx* lobes 4, narrowly imbricate, outer surface often with spiny outgrowths. *Petals* 1, usually fleshy, rudimentary ones often wanting. *Stamens* 10 (9 + 1), uppermost one free and reduced to a short staminode, the remaining 9 shortly and obliquely united at the base and sheath-like, the united part often hairy on both surfaces; 2 upper ones fertile with elongate filaments and ovoid or oblong, longitudinally dehiscing, dorsifixed anthers; 7 lower ones with shorter filaments and with or without small, imperfect anthers. *Ovary* with a short, free stipe, 2–5- (or more-) ovuled; style filiform, often recurvate; stigma small. *Pods* flat, rounded ovate or elliptic, often spiny, rarely unarmed, dehiscent, woody, 2-valved. *Seeds* few, black, shining, with a large fleshy aril at the base; cotyledons split; endosperm absent.

Distribution — A genus of 18–20 species, distributed in W Africa (Gabon, 1 sp.) and SE Asia; 15 of them in *Malesia* (Sumatra, Malay Peninsula, Borneo, W Java, Philippines, Celebes, and ?Moluccas).

Habitat — In lowland forests, favouring dry areas, sometimes occurring near the banks of brooks or small rivers, often scattered, growing singly or in small groups, up to 150 m, sometimes to 350 m, very rarely at higher altitudes.

Uses — Plants of some species produce strong and durable wood of excellent quality, resin or wood-oil, medicine, tannin, etc. See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 2031–2034; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 727–730; Sambas et al. in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 434–442.

Note — The present treatment is mainly based on the comprehensive revision of this genus published by De Wit (1949: 5–82).

KEY 1 TO THE SPECIES

(Based on flowering specimens)

- 1a. Leaflets minutely puberulous or pubescent on both surfaces . . . **1. *S. siamensis***
- b. Leaflets glabrous on both surfaces, or usually only minutely puberulous or pubescent on the lower surface, or rarely sparsely, fugaciously puberulous above . . . 2
- 2a. Leaflets glabrous on both surfaces 3
- b. Leaflets usually only minutely puberulous or pubescent on the lower surface, rarely sparsely, fugaciously puberulous above 7
- 3a. Apex of leaflets obtuse, rounded, retuse, or emarginate 4
- b. Apex of leaflets acute to acuminate 5
- 4a. Calyx lobes densely spinescent **13. *S. supra***
- b. Calyx lobes smooth, unarmed **10. *S. leiocarpa***
- 5a. Midrib on lower surface of the leaflet without a gland near the tip. (Stipules 2–2.5 cm long) **7. *S. inermis***
- b. Midrib on the lower surface of the leaflet with a gland near the tip 6
- 6a. Midrib narrow and shallowly grooved on the upper surface . . . **4. *S. coriacea***
- b. Midrib slightly prominent on the upper surface **6. *S. galedupa***
- 7a. Stamens 9, perhaps all fertile, the uppermost staminode absent **9. *S. javanica***
- b. Stamens not all fertile, stamens and staminodes 10, the uppermost staminode present 8
- 8a. Calyx lobes with spinescent outgrowths or warts 9
- b. Calyx lobes smooth, unarmed 12
- 9a. Leaves 3-jugate 10
- b. Leaves often 4- or 5-jugate 11
- 10a. Leaflets with apex shortly acuminate or acute. (Ovary warty, 1- or 2-ovuled) **12. *S. sumatrana***
- b. Leaflets with apex obtuse, the very tip slightly notched . . . **5. *S. echinocalyx***
- 11a. Calyx bearing some distinct, spiny outgrowths often at the upper half **15. *S. wallichii***
- b. Calyx bearing loosely, irregularly, minute, spiny outgrowths on the outer surface **1. *S. affinis***

- 12a. Leaflets 3- or 4-jugate. Petals hairy on the longitudinal, central part **2. *S. beccariana***
 b. Leaflets often 5- or 6-jugate. Petals glabrous inside 13
 13a. Ovary glabrous in the longitudinal, central part **3. *S. bruggemanii***
 b. Ovary all densely woolly 14
 14a. Undersurface of the leaflet usually densely tawny hirsute, sometimes slightly glabrescent **14. *S. velutina***
 b. Undersurface of the leaflet sparsely and minutely puberulous, glabrescent, sometimes almost glabrous except on the midrib **8. *S. irpicina***

KEY 2 TO THE SPECIES

(Based on collections with \pm ripe fruits)

- 1a. Pods armed or bearing spines 2
 b. Pods unarmed or smooth without spines 12
 2a. Leaflets obtuse, rounded, or retuse at the apex 3
 b. Leaflets acute to acuminate at the apex 5
 3a. Leaflets glabrous on both surfaces **13. *S. supra***
 b. Leaflets not glabrous on both surfaces 4
 4a. Leaflets minutely thinly puberulous above, more densely minutely puberulous to pubescent beneath **11. *S. siamensis***
 b. Leaflets glabrous above, puberulous beneath **5. *S. echinocalyx***
 5a. Leaflets with lower surface puberulous, pubescent, or tomentose 6
 b. Leaflets with lower surface usually glabrous, rarely bearing some fugacious hairs on or near the midrib 9
 6a. Spines on the pod dissolving into a brittle glossy, resinous crust **9. *S. javanica***
 b. Spines on the pod not like above, or sometimes only their tips resinous 7
 7a. Leaves often 5- or 6-jugate. Lower surface of leaflets pubescent or tomentose **14. *S. velutina***
 b. Leaves often 3- or 4-jugate. Lower surface of leaflets often minutely puberulous 8
 8a. Pods broadly ellipsoid or suborbicular, 7–8 cm wide, with scattered spines **2. *S. beccariana***
 b. Pods suborbicular, broadly obovoid or ellipsoid, 4–6 cm wide, with rather close spines **15. *S. wallichii***
 9a. Leaves 6–8-jugate **3. *S. bruggemanii***
 b. Leaves 3–5-jugate 10
 10a. Pods ovate-orbiculate, 3.1–3.9 by 2.7–3.1 cm **12. *S. sumatrana***
 b. Pods ellipsoid or oblong-ellipsoid, rarely slightly reniform, much larger, (5–)11–14 by (3–)5.5–8 cm 11
 11a. Pods covered with evenly spaced, numerous spines. Seeds broadly suborbicular, c. 1.8 cm long and wide **8. *S. irpicina***
 b. Pods (young) covered with scattered spines. Seeds: only very young ones seen **1. *S. affinis***

- 12a. Leaflets obtuse, rounded, or retuse **10. *S. leiocarpa***
 b. Leaflets vaguely or distinctly acuminate 13
 13a. Stipules rather large, 2–2.5 cm long. Pods broadly ovate, 5.5–6(–7) by 4.3–5 cm **7. *S. inermis***
 b. Stipules short, less than c. 1.5 cm long 14
 14a. Pods ellipsoid or slightly broadly ellipsoid, 7–10 by 4–6 cm. Aril almost as large as the seed, surface irregularly wrinkled **4. *S. coriacea***
 b. Pods suborbicular, orbicular, or broadly ellipsoid, 6–9.5 by 5–5.5 cm. Aril much smaller than the seed, on the surface with a smooth longitudinal rim
 **6. *S. galedupa***

1. *Sindora affinis* de Wit

Sindora affinis de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 16. — Type: *Neth. Ind. For. Serv. bb* 19774 (BO holo; L), Kalimantan.

Tree up to 35 m high and 60 cm in diam. *Stipules* caducous, not seen. *Leaves* (3–) 4- or 5- (6-)jugate; petiole 1.5–3(–5) cm and rachis 4–14 cm long, slightly puberulous, glabrescent, or almost glabrous. *Leaflets* firmly coriaceous, oblong or oblong-elliptic, elliptic, or ovate, 2.5–8(–9.5) by 2–4(–5) cm; apex shortly acuminate or acuminate; base rotundate, often symmetric; glossy and often almost glabrous on both surfaces, except sparsely hairy on the midrib of lower surface; petiolules very short, up to c. 3 mm, minutely puberulous, glabrescent. *Inflorescences* paniculate, 9–20 cm long, the lateral branches up to 5 cm long, both rachis and branches densely tawny puberulous, moderately flowered; bracts and bracteoles lanceolate, 3–4 mm long, densely puberulous; pedicels 1–3(–5) mm, densely puberulous. *Calyx* lobes elliptic or lanceolate, 7–10 by 3–5 mm, densely puberulous outside and appressed hairy inside. *Petal* elliptic, 8 by 2–3 mm, fleshy; outside densely puberulous and inside glabrous, margin villose. *Stamens*: free filaments and staminodes up to c. 12 mm, sparsely hairy often at the lower part or at base, or glabrous; 2 largest anthers ellipsoid, c. 2 mm long, the others (much) smaller, up to 0.75 mm long. *Ovary* subsessile or very shortly stiped, ovate-rhomboid, c. 2 mm long, densely woolly, 5- or 6-ovuled; style up to c. 15 mm, glabrous; stigma small. *Pods* (young) ellipsoid, slightly asymmetric, 5–8.5 by 3–4.5 cm, flattened, slightly minutely hairy, not veined, with scattered, very short spines, beak very short. *Seeds* only very young ones seen.

Distribution — *Malesia*: Borneo (Sabah, Kalimantan).

Habitat & Ecology — Lowland forest, growing in not inundated areas in sandy or clayey soils, once found in loam-soil on sandstone, up to 60 m altitude. Fl. April, July; fr. May.

2. *Sindora beccariana* de Wit

Sindora beccariana Baker ex de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 18, f. 2g–n; Cockb., Trees Sabah 1 (1976) 181, f. 39. — Type: *Beccari* 529 (BO holo; cf. De Wit, l.c.: f. 2g based on the type), Borneo.

Tree up to 44 m high and 77 cm in diam. *Stipules* caducous, not seen. *Leaves* 3- or 4-jugate; petiole 2.5–3.5 cm and rachis 8–14 cm long, slightly puberulous, glabrescent, or almost glabrous. *Leaflets* firmly coriaceous, elliptic, ovate-elliptic, or ovate, 3.5–8.5 by 1.7–4 cm; apex acuminate to attenuate; base rotundate, obtuse, or slightly cuneate, often symmetric; upper surface glossy and often almost glabrous; lower surfaces rather dull, densely minutely rusty puberulous; petiolules very short, up to c. 3.5 mm, minutely puberulous, glabrescent. *Inflorescences* paniculate, up to 16 cm long, lateral branches up to more than 5 cm long, both rachis and branches densely puberulous, moderately flowered; bracts and bracteoles ovate to lanceolate, 1–2.5 mm long, densely puberulous; pedicels 1–1.5 mm, densely puberulous. *Calyx* lobes narrowly imbricate, lanceolate or elliptic, 5.5–7 by 2–2.5 mm, unarmed, densely puberulous on both surfaces. *Petal* elliptic or slightly obovate-oblong, 5 by 2.5–3.5 mm, fleshy; outside densely puberulous in the lower half; inside glabrous except with appressed hairs on the longitudinal, central part; margin villose. *Stamens*: united part of the filaments c. 1 mm high; free filaments and staminodes up to c. 10 mm, hairy often on the lower half; anthers 2 (perfect) largest, ellipsoid, c. 2.5 mm long, the others (much) smaller, up to 1.5 mm long. *Ovary* subsessile or very shortly stipitate, ovate-rhomboid or broadly ovate, c. 4 mm long, densely woolly, 2- or 3-ovuled; style up to c. 12 mm, involute or recurvate, hairy at the basal part; stigma small. *Pods* purple, broadly ellipsoid or suborbicular, 7–9(–11) by 7–8 cm, flattened, hard, both surfaces evenly covered with scattered, sharp spines (c. 5 mm), beak very short. *Seeds* broadly ovate or suborbicular, c. 3.5 by 3 cm. — **Fig. 50g–n.**

Distribution — *Malesia*: Borneo (Sarawak, Sabah, Kalimantan).

Habitat & Ecology — In lowland forests in flat or sloping country, sometimes near the banks of brooks, scattered, rare or sometimes locally common, growing on dry, often sandy loam or clay soils. Altitude often below 100 m, once recorded from c. 850 m (Sabah). Fl. June, July, Nov.; fr. April–June, Sept.–Dec.

Uses — The timber is cut and exported as a fine joiners wood (Cockburn, l.c.).

Note — The hard pod is very characteristic, being evenly covered with sharp, straight spines.

3. *Sindora bruggemanii* de Wit

Sindora bruggemanii de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 21, f. 3. — Type: *de Wit s.n.*, collected 29 May 1941 from a tree cultivated in Bot. Gard. Bogor (BO holotype; L). See note.

Tree 20–30(–41) m high. *Stipules* connate in the lower half or almost entirely when very young, up to 10 mm long, puberulous on both surfaces, caducous. *Leaves* (5- or) 6–8-jugate; petiole 1.5–3.5 cm and rachis 11–22 cm long, pubescent, glabrescent. *Leaflets* coriaceous, elliptic, elliptic-oblong, lanceolate, rarely elliptic-obovate, 3.9–8.7 (–16) by 1.5–2.6(–5) cm, lower ones usually smaller than the upper ones; apex acuminate; base obtuse, rounded, often symmetric; upper surface glossy and almost glabrous; lower surfaces glossy, glabrous except pubescent on the midrib; petiolules very short, up to c. 5 mm, sparsely pubescent. *Inflorescences* paniculate, up to 20(–26) cm long.



Fig. 49. *Sindora bruggemanii* de Wit. Fruiting branch. Cultivated in Botanic Garden, Bogor, as nr. I-L-22. Photographer unknown.

lateral branches up to c. 4.5 cm long, both rachis and branches densely puberulous; bracts triangular, 3–4 mm long, densely puberulous; bracteoles minute, lanceolate, less than 1 mm long, puberulous on both surfaces; pedicels 3–5 mm, densely puberulous. *Calyx* lobes broadly lanceolate or ovate, 3.5–6 by c. 3 mm, unarmed, densely puberu-

lous outside, densely appressed hairy inside. *Petal* oblong-elliptic, 7–8.5 by 2–2.5 mm, fleshy; outside densely puberulous in the lateral parts of lower half; inside glabrous; margin villose. *Stamens*: filaments with basal parts connate c. 1 mm high, free filaments and staminodes up to c. 12 mm, sparsely hairy on the lower parts; anthers 2 (perfect) largest, ellipsoid, c. 3 mm long, the others smaller, c. 2 mm long. *Ovary* subsessile or very shortly stipitate, subrhomboid, c. 3 mm long, densely woolly along the suture, glabrous in the centre, with some minute protuberances observed under the dissecting microscope, 5–7-ovuled; style up to c. 12 mm, recurvate, glabrous or thinly puberulous in the basal part; stigma obscure. *Pods* on a stout peduncle up to 1.7 cm long, ellipsoid, oblong- or broad-ellipsoid, or broadly ovoid, 7.5–15 by 5.5–7 cm, flattened, hard, covered with some scattered, slender, sharp spines (up to c. 3 mm), beak recurvate, c. 10 mm long, 1–3-seeded. *Seeds* suborbicular or broadly ovoid, 1.5–2.3 by 1.5–2 cm, smooth, on top of a larger aril; aril very variable in shape and size, smooth or slightly irregular on the surface, slightly reniform, 2.5–2.8 by 1.5–1.8 cm. — **Fig. 49.**

Distribution — *Malesia*: Sumatra (Aceh, E & W Coast, Palembang), Borneo (Kali-mantan).

Habitat & Ecology — In lowland forests, up to 100 m altitude, along riverbanks or brooks, on clayey or sometimes sandy clayey soils, rare or very rare, only very locally more common, scattered or a few trees together. Fl. Sept., Oct.; fr. May, June.

Uses — Useful timber as other species.

Note — De Wit (l.c.) cited “*Teijsman 3697*, culta Hort. Bot. sub I.L.22, coll. 29.V. 1941” as the type of the present species. Dr. Elizabeth Widjaja (in litt.) kindly checked the relevant collections in BO. There is no herbarium specimen present of *Teijsmann 3697*, which may be a living collection brought back from Sumatra and planted in the Botanic Garden under nr. I-L-22. The collection made by De Wit as mentioned above, is the type of this species, not the other specimens collected from the same plant.

4. *Sindora coriacea* (Baker) Prain

Sindora coriacea (Baker) Prain, J. As. Soc. Beng. 66, ii (1897) 206, 482; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 30, f. 5; Whitmore in Tree Fl. Malaya 1 (1972) 271; Cockb., Trees Sabah 1 (1976) 182, f. 39; K. & S.S. Larsen in Fl. Thailand 4 (1984) 98, f. 25/7–8. — *Azelia? coriacea* Baker in Hook. f., Fl. Brit. India 2 (1878) 275. — Type: *Maingay 566* (K holo), Malay Peninsula.

Tree 18–33 m high and 31–95 cm in diam.; buttresses 60 cm high and spread. *Stipules* caducous, not seen. *Leaves* 3- or 4-jugate; petiole (1.5–)2.5–4 cm and rachis 5.5–10(–14) cm long, glabrous. *Leaflets* coriaceous, elliptic, ovate, or slightly obovate, (3.5–)5–10(–15) by (2–)3–5(–7.5) cm; apex shortly acuminate or acuminate, rarely rotund or retuse; base acute, cuneate, obtuse, or rotundate, sometimes unequally sided and often almost glabrous on both surfaces; petiolules very short, up to c. 5 mm, glabrous. *Inflorescences* paniculate, up to 20(–30) cm long, lateral branches up to 7 cm long, both rachis and branches densely puberulous; bracts and bracteoles ovate or lanceolate, 1.5–3 mm long, densely puberulous; pedicels 1–2.5 mm, densely puberulous. *Flowers* yellow, fragrant. *Calyx* lobes elliptic or lanceolate, 6.5–7.5 by 2.5–3 mm,

outside densely puberulous and without spiny outgrowths, densely appressed hairy inside. *Petal* slightly obovate-oblong, 6.5–7.5 by 3–3.5 mm; outside densely puberulous; inside glabrous except margin villose. *Stamens*: united basal parts of the filaments c. 2 mm high; free filaments and staminodes up to c. 12 mm, sparsely hairy often at lower part or at base, or glabrous; two largest anthers ellipsoid, c. 3.5 mm long, the others smaller, up to 1.5 mm long. *Ovary* subsessile, slightly ellipsoid, c. 4 mm long, densely woolly along the suture, 4- or 5-ovuled; style up to c. 10 mm, glabrous; stigma small. *Pods* (young) ellipsoid or slightly broadly ellipsoid, 7–10 by 4–6 cm, flattened, often unequally sided, slightly minutely hairy, faintly veined, unarmed, beak slightly curved, c. 8 mm. *Seeds* 2 or 3, arillate.

Distribution — Thailand (Peninsula); *Malesia*: Sumatra (E Coast), Malay Peninsula (widespread), Borneo (Sabah, Kalimantan).

Habitat & Ecology — In forests at low altitudes, favouring non-inundated sandy or leached soils. Fl. Feb.–Sept.; fr. throughout the year.

Note — The glabrous leaves and unarmed pods are characteristic for plants of the present species.

5. *Sindora echinocalyx* (Benth.) Prain

Sindora echinocalyx (Benth.) Prain, J. As. Soc. Beng. 66, ii (1897) 204, 481 (quoad Griffith 1848, excl. syn.); Symington, Kew Bull. (1938) 75, 77, f. B; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 34; Whitmore in Tree Fl. Malaya 1 (1972) 272, f. 1, 2, 11; K. & S.S. Larsen in Fl. Thailand 4 (1984) 99. — *Echinocalyx* Benth. in Benth. & Hook. f., Gen. Pl. 1 (1865) 584, 1003, pro gen. — Lectotype (Symington 1938; cf. De Wit, l.c.: 35); Griffith K distr. no. 1848 (K holo; L), Malay Peninsula.

Sindora wallichii auct. non Benth. in Benth. & Hook. (quoad Griffith 1848); Benth. in Hook., Ic. Pl. (1867) t. 1017; Ridley, Fl. Malay Penins. 1 (1922) 637, p.p.

Tree up to 40 m high and c. 70 cm in diam. *Stipules* foliaceous, subintrapetiolar, falcate, up to c. 8 mm long, acuminate, rounded auriculate at base, reticulate and finely puberulous on both surfaces, early caducous. *Leaves* 3- or 4-jugate; petiole 2–2.5 cm and rachis c. 7 cm long, minutely puberulous, glabrescent. *Leaflets* coriaceous, elliptic or elliptic-oblong, rarely obovate, 4–7.5 by 2–3 cm, lower ones usually smaller than the upper ones; apex obtuse, the very tip slightly notched; base obtuse or rotund, often symmetric; upper surface glabrous; lower surface puberulous especially on the midrib; petiolules very short or subsessile, up to c. 2.5 mm, pubescent, glabrescent. *Inflorescences* paniculate, up to 15 cm long, lateral branches up to c. 7 cm long, both rachis and branches densely puberulous; bracts and bracteoles triangular, ovate, or lanceolate, 4–7 mm long, puberulous on both surfaces; pedicels subsessile or very short, up to 3 mm, puberulous. *Calyx* lobes broadly ovate, or lanceolate, 4–5.5 by 1.5–2.5 mm, puberulous outside and bearing some spiny outgrowths outside, puberulous inside. *Petal* slightly obovate or elliptic, c. 5 by 2.5 mm; puberulous outside and glabrous inside. *Stamens*: united basal parts of the filaments very short; free filaments up to c. 10 mm, slightly hairy at the lower part; fertile anthers various in size, the larger ones ovoid-ellipsoid, c. 2.5 mm long, the others smaller. *Ovary* sessile, subrhomboid, c. 5 mm

long, densely hairy, with numerous minute, spiny outgrowths, 2–4-ovuled; style up to c. 10 mm, recurvate, glabrous or sparsely hairy in the basal part; stigma small, capitate. *Pods* on a very short peduncle, ovoid or broadly ellipsoid, or suborbiculate, 4–6.5 by 3.5–6 cm, flattened, covered with close, hard, straight spines (up to c. 4 mm); beak curve, c. 8 mm long; 1- or 2- (or 3-)seeded. *Seeds* arillate.

Distribution — Thailand (Peninsula); *Malesia*: Riau Archipelago, Malay Peninsula (common, throughout), Borneo (Sabah).

Habitat — In forests on hillsides and ridges, from lowland up to c. 600 m.

Notes — 1. There is one sterile sapling collection, *FRI 1202* (L), c. 6 m tall, bearing prominent foliaceous stipules (up to 18 by 8 mm), and rather larger leaflets (up to 15 by 7 cm) with acute or shortly acuminate apex and prominently reticulate venation on both surfaces.

2. *Sindora echinocalyx* is very closely allied to *S. wallichii* but can be distinguished from the latter even in sterile material by the leaflets with prominently reticulate venation on the upper surface (against smooth, shining and not reticulate).

6. *Sindora galedupa* Prain

Sindora galedupa Prain, J. As. Soc. Beng. 66, ii (1897) 483, quoad nomen, haud descr. et syn.; Sci. Mem. Med. Off. Army Ind. 12 (1901) 49; Merr., Interpr. Rumph. (1917) 254, 272; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 36, f. 6, 7. — [*Caju galedupa* Rumph., Herb. Amb. 2 (1741) 59, t. 13, pro tab. et parte maiore descr.] — [*Galedupa ceramensis* Rumph., Herb. Amb. 2 (1741) 60, p.p.] — *Galedupa indica* Lam., Encycl. Méth. 2 (1788) 594, quoad nomen, haud descr. — Lectotype (De Wit 1949): *Caju galedupa* Rumph., Herb. Amb. 2 (1741) 59, t. 13.

Tree up to 25 m high. *Stipules* foliaceous, acinaciform, falcate, up to c. 15 mm in diam., acuminate, rounded auriculate at base, reticulate glabrous, tardily caducous. *Leaves* 4- (or rarely 3-)jugate; petiole 1–3.2 cm and rachis 7.7–13.6 cm long, minutely puberulous, glabrescent, or glabrous. *Leaflets* thinly coriaceous, elliptic or elliptic-oblong, ovate-oblong or sometimes obovate, 3.5–12.5 by 2.5–7 cm, often glabrous, sometimes puberulous on the lower surface when young; apex acute, subacuminate, obtuse, the very tip slightly notched; base obtuse or rotund, sometimes subtruncate or subacute, often more or less unequally sided; petiolules short, up to c. 5 mm, puberulous, glabrescent, or glabrous. *Inflorescences* paniculate, up to 17(–37) cm long, lateral branches up to c. 3.5(–9) cm long, both rachis and branches densely puberulous; bracts and bracteoles lanceolate, up to 3 mm long, densely puberulous on both surfaces; pedicels short, up to 5 mm, puberulous. *Flowers* dirty yellow or light brown, margins pink, fragrant. *Calyx* lobes lanceolate, up to 9.5 by 3 mm, outside unarmed, puberulous, inside tomentose. *Petal* elliptic or oblong-elliptic, 5–6.5 by 2–2.5 mm; outside densely puberulous in the lower half; glabrous inside. *Stamens*: united basal parts of the filaments very short; free filaments up to c. 6 mm, slightly hairy; (fertile) anthers various in size, the 2 larger ones ovoid-ellipsoid, c. 3.5 mm long, the others smaller. *Ovary* subsessile, subrhomboid, c. 3 mm long, densely hairy on the margin, glabrous in the centre, 3-ovuled; style up to c. 10 mm, recurvate, hairy at the base, sparsely hairy in the upper part; stigma terminal, small, capitate. *Pods* at almost 90° on a short peduncle (c. 1 cm),

suborbicular, orbicular, or broadly ellipsoid, 6–9.5 by 5–5.5 cm, flattened, smooth, beak very short, recurvate, c. 5 mm long; 1- or 2-seeded. *Seeds* suborbicular or broadly ellipsoid, c. 2 by 1.8 cm, smooth, compressed, on a smaller aril (0.85 by 1.2 cm).

Distribution — *Malesia*: Celebes (Manado, Saleijer, Wandji = Wangiwangi), Lesser Sunda Islands (Flores), Moluccas (Banda, Rau, Morotai, Kai).

Habitat & Ecology — In lowland forest, flat country, often below 100 m, once found occurring at 1000 m altitude. Fl. April, May, July; fr. April, May, July, Dec.

Note — De Wit (1949) made a comprehensive study of this species, discussing its history of nomenclature, specific concept, typification, distribution, etc.

7. *Sindora inermis* Merr.

Sindora inermis Merr., Philipp. J. Sc., Bot. 10 (1915) 314; Interpr. Rumph. (1917) 254; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 48, f. 9. — Type: *FB 23054* (PNH holo, destroyed; BO), Mindanao.

Tree up to c. 30 m high. *Stipules* falcate and comparatively broad, 1–2(–2.5) by 1 cm, base broadly auricled, apex acute, glabrous and densely, finely reticulate on both surfaces (to be observed with a hand-lens), persistent (?) during anthesis. *Leaves* 2–4-jugate; petiole 2–4.3 cm and rachis 8–12(–15) cm long, both tawny light brown puberulous, glabrescent or glabrous. *Leaflets* thinly coriaceous, elliptic, broad- or ovate-elliptic, sometimes ovate or obovate, 6.5–13 by 4.5–7.5 cm, asymmetric; apex bluntly shortly acuminate; base cuneate to rotund, often slightly asymmetric; glossy and glabrous on both surfaces, except sparsely hairy on the midrib of lower surface; petiolules very short, c. 3 mm, sparsely puberulous, glabrescent, or almost glabrous. *Inflorescences* and flowers not seen. *Pods* (only valves seen) broadly ovate, flattened, on a peduncle (c. 7 mm long) 5.5–6(–7) by 4.3–5 cm, with a rather off centre, short beak, unarmed, slightly veined, glabrous. *Seeds* not seen.

Distribution — *Malesia*: Philippines (S Luzon to Mindanao and Jolo).

Habitat — In forests along the seashore and at low altitudes inland.

Uses - The trunks of this species yield an oil with pleasant persistent odour and said to be useful in the perfume industry. It has been exported in small quantities to Singapore [Brown, Min. Prod. Philipp. For. 2 (1921) 37–38, with tab.].

8. *Sindora irpicina* de Wit

Sindora irpicina de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 50, f. 10; Cockb., Trees Sabah 1 (1979) 182, pl. 11, f. 39. — Type: *Jaheri* (*Exp. Nieuwenhuis*) 908 (BO holo), Kalimantan.

Tree up to 40 m high and 80 cm in diam. *Stipules* caducous, not seen. *Leaves* (3–)5-jugate; petiole 2.3–3.8 cm and rachis 7.5–19.5 cm long, slightly puberulous, glabrescent, or almost glabrous. *Leaflets* coriaceous, elliptic, oblong-elliptic or rarely obovate, 5.4–10.5 by 2.1–4.8 cm; apex acuminate to attenuate; base obtuse, rounded, acute or slightly cuneate, often symmetric; upper surface glossy and glabrous; lower surfaces glossy, sparsely and minutely puberulous, glabrescent, sometimes almost glabrous ex-

cept on the midrib; petiolules very short, up to c. 6 mm, minutely puberulous, glabrescent. *Inflorescences* paniculate, up to 16 cm long, lateral branches straight, 1–4 together, up to 4.5 cm long, both rachis and branches pubescent; bracts and bracteoles usually not present on dry specimens, rarely bracteoles observed on young flowers, lanceolate, up to c. 3 mm long, densely puberulous; pedicels 3–5 mm, densely puberulous. *Calyx* lobes lanceolate, 3.5–6 by c. 3 mm, unarmed, puberulous outside, densely appressed hairy inside. *Petal* ovate, 5 by 3 mm, deeply concave to involute, outside densely puberulous in the lateral parts, inside glabrous, margin villose. *Stamens*: united basal parts of the filaments c. 1 mm high; free filaments and staminodes up to c. 10 mm, sparsely hairy in the lower half; anthers 2 (perfect) largest, ellipsoid, c. 0.35 mm long, the others much smaller. *Ovary* subsessile or very shortly stiped, ovate, c. 4 mm long, densely woolly, with many minute outgrowths, 3–5-ovuled; style up to c. 14 mm, involute or recurvate, hairy at the basal part; stigma small. *Pods* black, on a stout peduncle (1–1.5 cm long), ellipsoid or oblong-ellipsoid, rarely slightly reniform, 11–14 by 5.5–8 cm, flattened, hard, covered with evenly spaced, numerous, slender, sharp spines (c. 3 mm), beak almost straight, 3.5–8 mm long, 1–3-seeded. *Seeds* broadly suborbicular, c. 1.8 cm long and wide, smooth, on top of a large, reniform aril (c. 3 by 1.5 cm).

Distribution — *Malesia*: Borneo (Brunei, Sarawak, Sabah, Kalimantan).

Habitat & Ecology — In lowland forests, often near the banks of brooks, on sandstone, sandy limestone, shales, sandy and volcanic soils, up to 700 m altitude. Fl. May–July; fr. Feb.–April, June–Sept., Nov.

Note — The present species can be easily recognized by 1) leaves 3–5-jugate, 2) leaflets glabrous above, 3) ovary densely woolly, with many minute outgrowths (to be observed with the dissecting microscope), 4) pods bearing scattered, evenly disposed spines, and 5) the seed on a large, reniform aril.

9. *Sindora javanica* (Koord. & Valeton) K. Heyne

Sindora javanica (Koord. & Valeton) Backer ex K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 728; Backer, Blumea 5 (1945) 508; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 53, f. 11; Backer & Bakh. f., Fl. Java 1 (1964) 527. — *Sindora sumatrana* var. *javanica* Koord. & Valeton, Bijdr. Booms. Java 2 (1895) 45. — Lectotype (De Wit 1949); *Koorders 14915* (BO holo), Java.

Tree 25–35 m high. *Stipules* early caducous. *Leaves* 4- or 5-jugate; petiole 2.5–3 cm and rachis 7–12.5 cm long, pubescent when young, minutely puberulous, glabrescent. *Leaflets* coriaceous, elliptic, elliptic-oblong, rarely obovate-elliptic or elliptic-obovate, 3.5–14.5 by 1.8–6.5 cm, lower ones usually smaller than the upper ones; apex shortly acuminate to acuminate; base obtuse, rounded, slightly asymmetric; upper surface glossy and minutely sparsely puberulous, glabrescent and sometimes almost glabrous; lower surface glossy, puberulous especially on the midrib; petiolules very short, up to c. 5 mm, pubescent, glabrescent. *Inflorescences* paniculate, up to 30 cm long, lateral branches up to c. 7 cm long, both rachis and branches densely puberulous; bracts ovate to lanceolate, 3–4 mm long, puberulous on both surfaces; pedicels very short. *Calyx* unarmed, lanceolate, 6–9 by 2–3 mm, densely puberulous, densely appressed hairy inside. *Petal*

slightly obovate-oblong or elliptic, 6–7 by c. 2 mm; outside densely puberulous and inside glabrous; margin villose. *Stamens*: united basal parts of the filaments very short; free filaments up to c. 10 mm, hairy; anthers perhaps all fertile, various in size, largest, ovoid-ellipsoid, c. 3.5 mm long, the others smaller. *Ovary* subsessile or very shortly stipitate, subrhomboid, c. 7 mm long, densely woolly, except with somewhat shorter hairs in the centre, 3–5-ovuled; style up to c. 12 mm, recurvate, glabrous or sparsely hairy in the basal part; stigma obscure. *Pods* on a stout peduncle (up to c. 8 mm), ellipsoid, sometimes suborbicular, 6–8.5 by 3.5–5.5 cm, flattened, covered with scattered, slender spines (on a thickly swollen base, profusely excreting resin which covers the pod surface, the spines then fallen), beak short, recurvate, c. 7 mm long; 2- or 3-seeded. *Seeds* suborbicular, compressed, c. 1.5 cm (c. 2 cm when fresh) in diam., blackish, smooth, on top of a large aril; aril larger or slightly smaller than the seed, wider than high, up to 1.7 cm (up to c. 2.5 cm when fresh) wide, wrinkled when dry.

Distribution — *Malesia*: Java (Preanger and Banjumas).

Habitat & Ecology — In forest usually on poor, sandy or stony soils, rather rare, occurring below 500 m altitude. Fr. April, June.

Note — According to De Wit (l.c.: 57), the present species holds a rather isolated position in the genus because of the absence of the uppermost free staminodium and the excessive resin excretion of the spines of the pods.

10. *Sindora leiocarpa* de Wit

Sindora leiocarpa Backer ex de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 58, f. 12; Cockb., Trees Sabah 1 (1976) 181, f. 40. — Type: *Grashoff 667* (L holotype), Sumatra.

Tree 25–40(–45) m high and 45–80 cm in diam. *Stipules* lanceolate, 3–5 mm long, almost glabrous except slightly puberulous on the midrib beneath and on margins, caducous. *Leaves* (2- or 3- (or 4-)jugate; petiole 1.5–2.8 cm and rachis 4–11 cm long, both minutely puberulous, glabrescent, or almost glabrous. *Leaflets* thinly to rigidly coriaceous, elliptic, obovate- or broad-elliptic, 2.5–5(–9.5) by 2–3(–5) cm; apex obtuse, acute, or shortly acuminate, sometimes slightly emarginate; base obtuse or cuneate, slightly asymmetric; glabrous on both surfaces, except sometimes sparsely hairy on the midrib of lower surface; petiolules very short, up to c. 4 mm, slightly puberulous, glabrescent or glabrous. *Inflorescences* paniculate, up to 16(–25) cm long, lateral branches up to over 5 cm long, both rachis and branches densely pubescent; bracts and bracteoles ovate, up to 4 mm long, densely puberulous; pedicels 1–1.5 mm, densely puberulous. *Flowers* yellow, yellowish brown. *Calyx* lobes elliptic or elliptic-oblong, obovate, or ovate, 4.5–5(–6) by 2–3(–3.5) mm, no spiny outgrowths on the outer surface, densely puberulous outside, appressed hairy insides. *Petal* 5–6 mm long, slightly longitudinally folded and somewhat bent inward from the middle, the lower half (claw) densely puberulous outside and glabrous inside, the upper half (limb) glabrous except villose margin. *Stamens*: united basal parts of the filaments 2–3 mm high; free filaments and staminodes up to c. 7 mm, ciliate; 2 largest anthers ellipsoid, 2–2.5 mm long, the others (much) smaller, up to 0.75 mm long. *Ovary* subsessile or shortly stipitate (c. 1 mm),

slightly obovate or elliptic, c. 2 mm long, densely woolly along the margins; style 8–10 mm, glabrous; stigma obscure. *Pods* ellipsoid, ovoid, broadly ovoid, or suborbicular, 5–9 by 4.5–5.8 cm, flattened, smooth, obscurely veined, almost glabrous, beak up to 8(–14) mm long, recurvate, 1–3-seeded. *Seeds* broadly ovoid or suborbiculate, c. 13 (–21) mm long, smooth, black; aril broader than high, often larger than the seed, smooth or rugose.

Distribution — *Malesia*: Sumatra (Jambi, Palembang, Riau), Borneo (Sarawak, Brunei, Sabah, Kalimantan).

Habitat & Ecology — In flat or sloping areas in lowland forest, occurring often on dryland, sometimes on sandy loam-soil, occasionally in secondary forest and seasonal freshwater swamp, usually below 100 m, rarely up to 412 m altitude. Fl. Jan., March–June, Aug.–Dec.; fr. Jan., March–May, Aug.–Dec.

Uses — The wood has little value. It is used for boards, partition walls and household utensils.

Note — 1. In the Arboretum, Semengoh Forest Reserve, Kuching (Sarawak), there is one tree of this species under the number 682 (see coll. *S 14921*, L).

2. This species is characterized by the combination of the following characters: 1) the leaves (2-) 3- (4-)jugate, 2) leaflets thinly to rigidly coriaceous, almost glabrous except midrib pubescent below, and with finely, closely reticulate venation, 3) inflorescences and flowers densely tawny pubescent or puberulous, 4) petal slightly folded longitudinally and somewhat bent inward from the middle, and 5) pods smooth.

11. *Sindora siamensis* Miq.

Sindora siamensis Teijsm. ex Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 36; Ridley, Fl. Malay Penins. 1 (1922) 638; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 62, f. 13; Whitmore in Tree Fl. Malaya 1 (1972) 272. — *Sindora wallichii* var. *siamensis* (Teijsm. ex Miq.) Baker in Hook. f., Fl. Brit. India 2 (1878) 268. — Type: *Teijsmann 6050 HB* (BO), Thailand.

This species has been divided into two varieties: var. *siamensis*, as treated here, and var. *maritima* (Pierre) K. & S.S. Larsen, distributed in Cambodia and Thailand.

var. *siamensis*

K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 125, pl. 21/1–4; in Fl. Thailand 4 (1984) 100, f. 25/1–5.

Tree. *Stipules* foliaceous, falcate, up to c. 18 mm long, acuminate, rounded auriculate at base, reticulate and puberulous on both surfaces, caducous. *Leaves* (2- or 1-) 3- or 4-jugate; petiole 3–4 cm and rachis up to c. 10.5 cm long, both puberulous, glabrescent. *Leaflets* coriaceous, elliptic, elliptic-oblong, or broadly elliptic, (3.5–)6–12.5(–15) by (2.3–)4–6.5(–8) cm, upper pair slightly larger than the others; apex rounded, emarginate; base acute, obtuse or rotund, sometimes slightly unequal-sided; upper surface minutely thinly puberulous all over (slightly rough to the touch), glabrescent; lower surface puberulous, especially more densely on the midrib; petiolules short, up to c. 5 mm, finely puberulous, glabrescent. *Inflorescences* paniculate, up to 27(–35) cm long, lateral

branches up to c. 6(–12) cm long, both rachis and branches densely puberulous or pubescent; bracts foliaceous, broadly ovate, 4–7 mm long, puberulous on both surfaces, persistent; bracteoles ovate to lanceolate, c. 5 mm long, puberulous on both surfaces, persistent; pedicels up to c. 4 mm, puberulous. *Calyx* lobes broadly elliptic, elliptic, or lanceolate, 7.5–9 by 3–3.5 mm, outside puberulous, bearing several spinescent outgrowths near the apex and often showing numerous warts all over, inside strigose. *Petal* elliptic or slightly oblong-elliptic, 7–9 by 2.5–3 mm, fleshy, woolly outside, glabrous inside. *Stamens*: the united basal parts of filaments very short; free filaments 15–20 mm, slightly hairy at the lower part; fertile anthers various in size, the larger ones ovoid-ellipsoid, 3–3.5 mm long, the others smaller. *Ovary* subsessile, ellipsoid, flattend, c. 4.5 mm long, densely hirsute, with minute, spiny outgrowths, 3–8-ovuled; style up to c. 15 mm, recurvate, glabrous or sparsely hairy in the basal part; stigma capitate. *Pods* on a very short peduncle, irregularly ovoid or broadly ellipsoid, 4–10 by 3.5–6.5 cm, flattened, covered with hard, straight, irregularly disposed spines (up to c. 4 mm); beak curvate, up to c. 7 mm long; 1–7-seeded. *Seeds* on top of a large aril, orbicular or broadly ellipsoid, flattened, 15–25 by 14 by 17 mm; aril (dry) cushion-shaped, c. 10 by 15 mm, irregular on the surface.

Distribution — Thailand, Cambodia, Laos, Vietnam; *Malesia*: Malay Peninsula (see note 1).

Habitat & Ecology — In lowland forests. Fl. and fr. Sept. Pollination of the flowers is effected by flies.

Uses — The wood is used for planking. See Foxworthy, Mal. For. Rec. 3 (1927) 272; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 2033.

Notes — 1. There is only one collection of *Sindora siamensis* from the Malesian area, made by Ridley in Kelantan (cf. Whitmore, l.c.).

2. In var. *siamensis* the upper surface of the leaflet is minutely thinly puberulous and slightly rough to the touch. It is very characteristic and can be used to recognize the plants of this variety from other taxa in *Sindora*.

12. *Sindora sumatrana* Miq.

Sindora sumatrana Miq., Fl. Ind. Bat., Suppl. (1860) 107, nom. nud.; ditto (1861) 288, descr.; Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 86; Koord. & Valeton, Bijdr. Booms. Java 2 (1895) 45; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 66, f. 2a–f. — Type: *Teijsmann s.n.* (L holo or iso), Sumatra.

Tree. *Stipules* reniform, 4 by 12 mm, glabrous, caducous. *Leaves* often 3-jugate; petiole up to 3 cm and rachis up to 9.5 cm long, puberulous when young, glabrescent, or glabrous. *Leaflets* coriaceous, elliptic, ovate- or obovate-oblong, rarely slightly

Fig. 50. *Sindora sumatrana* Miq. a. Fruiting branch; b. leaflets; c, d, e. fruits and seeds; f. stipule. — *Sindora beccariana* Baker ex de Wit. g. Habit; h. inflorescence; i. bud; j. pistil; k. petal outside; l. petal inside; m. stamens and petal; n. pod (a–f: *Teijsmann HB 3753*; g–n: *Beccari PB 529*. Reproduced from Bull. Bot. Gard. Buitenzorg III, 18.



obovate, 6–11.5 by 2.5–6.5 cm; apex shortly acuminate or acute; base rotundate, obtuse, subcuneate or acute, sometimes slightly unequally sided and often almost glabrous on both surfaces; petiolules very short, up to c. 5 mm, almost glabrous. *Infructescences* paniculate, up to 13 cm long, lateral branchlets up to 3.5 cm long. *Pods* ovate-orbiculate, 3.1–3.9 by 2.7–3.1 cm, flattened, often unequally sided, glabrous, with rather moderately spaced, short spines, situated on a swollen base with abundant resin; beak short (c. 2 mm), straight or slightly curved. *Seeds* 1 or more, situated almost in the centre part of the pod on top of a small aril, suborbicular, c. 1 cm in diam., black. — **Fig. 50a–f.**

Distribution — *Malesia*: Sumatra (Palembang), Bangka (Lepar Is.).

Habitat & Ecology — According to Teijsmann the tree occurs in the region of Palembang on sandy soils only and preferably in periodically inundated areas. Fr. Feb., May.

Uses — Cultivated in Java: Bawean Is.

The resinous wood oil is used in mixtures (with Oleum Dempel) for caulking boats. The fruits are exported and sold as medicine. The timber is locally abundant and used for furniture. See Foxworthy, Philipp. J. Sc., Bot. 4 (1909) 471; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 2032; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 729.

13. *Sindora supa* Merr.

Sindora supa Merr., Philipp. J. Sc., Suppl. 1 (1906) 198; Philipp. J. Sc., Bot. 10 (1915) 315; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 69. — Type: *Merrill 2611*, Tayabas.

Sindora wallichii var. *intermedia* auct. non Baker: Fern.-Vill., Nov. App. (1880) 71.

Sindora wallichii auct. non Benth.: Vidal, Sinopsis Atlas (1883) 24, 43, f. C; Rev. Pl. Vasc. Filip. (1886) 118; Merr., Bull. Bur. For. Philipp. 1 (1903) 23.

Tree 15 m high and 30 cm in diam.; bark black to nearly brown in colour, shed in large scales and exposing pink coloured patches. *Stipules* lanceolate or subfalcate, 12–14 mm long, much unequally sided, pubescent, glabrescent on the outside, glabrous inside, base hemi-auriculate, caducous. *Leaves* (2- or 3- (or 4-)jugate; petiole 1.2–2.5 cm and rachis (1.5–)3–6(–7.2) cm long, both minutely puberulous, glabrescent, or almost glabrous. *Leaflets* thinly coriaceous, elliptic or obovate-elliptic, elliptic, 2.5–5(–8.5) by 2–3(–4.5) cm; apex obtuse, acute, or shortly acuminate, sometimes slightly emarginate; base obtuse or cuneate, slightly asymmetric; glabrous on both surfaces, except sometimes sparsely hairy on the midrib of lower surface; petiolules very short, up to c. 4 mm, slightly puberulous, glabrescent or glabrous. *Inflorescences* paniculate, up to 15(–20) cm long, lateral branches up to 5(–10) cm long, both rachis and branches densely tawny pubescent; bracts lanceolate, (4–)6–8 mm, bracteoles resembling bracts but about half the size, both with some distinctly spiny outgrowths (up to c. 4 mm long), densely appressed puberulous on both surfaces; pedicels c. 1.5(–4) mm, densely puberulous. *Calyx* lobes elliptic, oblong, or lanceolate, (6.5–)10–12 mm long, bearing up to c. 10 (–23) slender, easily detached, puberulous, spiny outgrowths on the outer surface, densely puberulous outside, appressed shortly hairy inside. *Petal* narrowly elliptic or lanceolate, 10–12 mm long, densely puberulous outside and villose on the margins, glabrous inside. *Stamens*: united basal parts of filaments c. 3 mm high; free filaments and

staminodes up to c. 18 mm, puberulous on the lower 1/2–1/3; perfect anthers 2 (biggest), ellipsoid, c. 3.5 mm long, the others (much) smaller. *Ovary* stiped (c. 3 mm), rhomboid, c. 3 by 2 mm, woolly mingled with many dot-like outgrowths (dissecting microscope or hand-lens!); style up to c. 23 mm, slightly hairy on about the lower 10 mm, otherwise glabrous; stigma capitate. *Pods* (young) broadly ellipsoid, 4–5 by 3–3.5 cm, flattened, bearing many more or less evenly placed, straight, sharp spines (c. 5 mm long), fugaciously pubescent on and among the spines, 2-seeded (impressions on the inner surface of the valves). *Seeds* (not seen, observed from the impressions) broadly elliptic, c. 3 by 2 cm (fide Merrill, l.c. 1906: seeds 2 to 4, ovate, hard, black, with an arillate funicle).

Distribution — *Malesia*: Philippines (Luzon, Tayabas Prov.).

Habitat & Ecology — In forests at low and medium altitudes; occurring on limestone ridges. Fl. March, April; fr. April.

Uses — An important timber tree. Its wood is used for naval and general constructions and is often substituted for the more valuable Ipil wood [*Intsia bijuga* (Colebr.) Kuntze].

A light yellow or straw-coloured oil is secured from the wood of the living tree. It is used in the manufacture of paint, especially for use on ships, varnish for sailing boats and as an illuminant. See Brown, *Minor Prod. Philipp.*, Bot. 2 (1921) 38, cum tab.; Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 2032.

Note — The present species is characterized by: 1) leaves often 3-jugate, 2) leaflets usually almost glabrous with finely and closely reticulate venation, 3) bracts, bracteoles and calyx lobes bearing spinescent outgrowths on the outer surface, 4) fruits having almost evenly spaced, straight, sharp spines, and 5) stipules foliaceous, much unequally sided, lanceolate, or subfalcate and hemi-auriculate at the base.

14. *Sindora velutina* Baker

Sindora velutina Baker in Hook. f., *Fl. Brit. India* 2 (1878) 269; Ridley, *Fl. Malay Penins.* 1 (1922) 638; de Wit, *Bull. Bot. Gard. Buitenzorg III*, 18 (1949) 72, f. 14; Whitmore in *Tree Fl. Malaya* 1 (1972) 273; Meijer, *Field Guide Trees W. Mal.* (1974) 195; Cockb., *Trees Sabah* 1 (1976) 181, f. 40, p.p. — Type: *Maingay 607* (K holo), Malay Peninsula.

Sindora mucronata Pierre, *Fl. For. Coch.* (1899) sub t. 385. — Type: *de Vriese s.n.* (L iso), Sumatra. *Sindora parvifoliola* Symington, *Kew Bull.* (1938) 77. — Type: *CF 4192* (KEP), Malay Peninsula.

Tree 15–37.5(–54) m high and 18–79(–95) cm in diam.; buttresses very short. *Stipules* lanceolate, c. 8 mm long, densely hirsute outside, glabrous inside, caducous. *Leaves* (3–)5- or 6- (or 7-)jugate; petiole 2–3(–5) cm and rachis 5–16(–22.5) cm long, both tawny woolly or densely tomentose when young and later thinner. *Leaflets* coriaceous, ovate-elliptic or elliptic, sometimes ovate or broadly ovate, 3–9(–14.5) by 1.5–4.5(–7.5) cm; apex shortly or normally acuminate, sometimes acute; base rotund or obtuse, usually symmetric; upper surface glossy and glabrous, rarely sparsely hairy near the midrib, lower surface usually densely tawny hirsute sometimes slightly glabrescent; petiolules very short, up to c. 3 mm, rather sturdy, hirsute sometimes glabrescent. *Inflorescences* paniculate, up to 11(–20) cm long, lateral branches up to c. 3 cm long, compactly flow-

ered, both rachis and branches densely brown hirsute; bracts lanceolate, c. 3 by 1.5 mm, densely appressed hirsute outside; bracteoles resembling bracts but about half the length; pedicels very short, densely hirsute. *Calyx* lobes oblong-lanceolate, 11–13 mm long, unarmed, densely hirsute often on both surfaces. *Petal* narrowly lanceolate, 10–12 mm long, densely woolly outside, glabrous inside. *Stamens*: united basal parts of filaments very short; free filaments and staminodes up to c. 1.5 cm, hirsute towards the lower 1/2–1/3; perfect anthers 2 (biggest), 3.5–4 mm, the others (much) smaller. *Ovary* sessile, rhomboid, c. 3 by 2.5 mm, woolly; style up to c. 1.5 cm, glabrous; stigma capitate. *Pods* elliptic-ovate or broadly ovate, slightly irregular in shape, 6–11.7(–15) by 5–6.5(–8) cm, with a rather short beak, thinly hirsute, bearing rather small, scattered, moderately developed sharp spines (c. 4 mm long), with fine warts among them, 1–4-seeded. *Seeds* irregularly ovoid, 1.6–2.2 cm both long and wide, flattened, smooth, purple-black, almost glossy, on top of an aril longer than wide (c. 2.6 cm wide).

Distribution — *Malesia*: Sumatra (Riau, Palembang), Malay Peninsula (scattered throughout), Borneo (Sarawak, Sabah, Kalimantan).

Habitat & Ecology — In the forest of dryland, hillsides, rarely along riverbanks and in swamps, growing usually scattered, in low altitude usually below 100 m, rarely up to 360 m altitude. Fl. March–May, July, Oct., Nov.; fr. Feb., May, June, Sept., Nov., Dec.

Uses — The wood is said to be soft and subject to attacks by white ants and other insects. It splits when drying. It is used for beams and rafters for house-building and for household utensils and boards. See Foxworthy, Mal. For. Rec. 3 (1927) 92; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 2070; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 729; De Wit, l.c.: 76.

Note — Plants of *Sindora velutina* can be easily recognized by the densely rusty pubescent, tomentose, or woolly branchlets, axis of the inflorescences or infructescences, and undersurfaces of leaflets, as alluded by the specific epithet. Mature pods bear short spines.

15. *Sindora wallichii* Benth.

Sindora wallichii Benth. in Hook., Icon. Pl. 11 (1867) sub t. 1018, excl. t. 1017; Prain, J. As. Soc. Beng. 66, ii (1897) 203, 481 ('*wallichiana*'); Ridley, Fl. Malay Penins. 1 (1922) 637; Symington, Kew Bull. (1938) 75, 77, f. A; de Wit, Bull. Bot. Gard. Buitenzorg III, 18 (1949) 76, f. 15; Whitmore in Tree Fl. Malaya 1 (1972) 273; Cockb., Trees Sabah 1 (1976) 181. — Type (see Prain, l.c.; Symington, l.c.; de Wit, l.c.): *Wallich* 5805 (K lecto; BM, L photo), Singapore.

Sindora intermedia (Baker) Prain, J. As. Soc. Beng. 66, ii (1897) 204, 482; Ridley, Fl. Malay Penins. 1 (1922) 638, p.p. — *Sindora wallichii* var. *intermedia* Baker in Hook. f., Fl. Brit. India 2 (1878) 268. — Type: Maingay 3142 (= *K* distr. 562) (*K* holo), Malay Peninsula.

Tree up to 24(–33) m high, 67 cm in diam. *Stipules* foliaceous, subintrapetiolar, falcate, up to 15 mm long, acuminate, rounded auriculate at base, reticulate and finely puberulous on both surfaces, tardily caducous. *Leaves* 3- or 4-jugate; petiole 1.2–2.5 cm and rachis 4.5–8.5 cm long, minutely puberulous, glabrescent, or sometimes glabrous in the upper half. *Leaflets* coriaceous, elliptic-ovate or elliptic-oblong, ovate- or obovate-oblong, 4–10.5 by 2.5–5 cm, upper pair usually the largest; apex acute, subacuminate,

obtuse, the very tip slightly notched; base obtuse or rotund, often more or less unequally sided; upper surface brightly glossy and glabrous, sometimes puberulous in the lower half or very minutely puberulous all over; lower surface rather dull and glabrous or densely pubescent; petiolules very short or subsessile, up to c. 3 mm, puberulous, glabrescent, or glabrous. *Inflorescences* paniculate, up to 24 cm long, lateral branches zigzagging, rather short, up to c. 4.5 cm long, both rachis and branches densely puberulous; bracts triangular, wider than long, up to 4 mm long and 7 mm wide, puberulous on both surfaces; bracteoles oblong or lanceolate, c. 4.5 mm long, puberulous on both surfaces; pedicels almost absent or very short, up to 4 mm, puberulous. *Calyx* lobes lanceolate, up to 9.5 by 3 mm, outside puberulous and bearing some distinctly spiny outgrowths often in the upper half, inside glabrous. *Petal* elliptic or oblong-elliptic, c. 8 by 2–2.5 mm; outside woolly; glabrous inside. *Stamens*: united basal parts of the filaments very short; free filaments up to c. 10 mm, slightly hairy at the lower part; (fertile) anthers various in size, the 2 larger ones ovoid-ellipsoid, c. 3.5 mm long, the others smaller. *Ovary* sessile or shortly stiped, subrhomboid, c. 5 mm long, densely hairy, with many minute, spiny outgrowths, 2–4-ovuled; style up to c. 10 mm, recurvate, glabrous or sparsely hairy in the basal part; stigma terminal, small, capitate. *Pods* on a very short peduncle, suborbicular, broadly obovoid or ellipsoid, 6–10 by 4–6 cm, flattened, both surfaces covered with close, hard, straight spines (up to c. 5 mm); beak curvate, c. 8 mm long; 1- or 2- (or 3-)seeded. *Seeds* suborbicular, c. 2 cm in diam., on a larger aril (often broader than long).

Distribution — *Malesia*: Sumatra (E Coast, Jambi, Palembang, Riau Archipelago), Malay Peninsula, Borneo (Sabah, Kalimantan).

Habitat & Ecology — In lowland forests, on non-inundated sandy or sometimes clayey soils, sometimes near mangrove swamp, often below 100 m, sometimes up to 300 m altitude. Fl. March, May, July, Oct.–Dec.; fr. Jan., March, May, Aug., Dec.

SYMPETALANDRA

(Ding Hou)

Sympetalandra Stapf in Hook., Icon. Pl. IV, 8 (1901) t. 2721; Steenis, Blumea 22 (1975) 162; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 95; Watson & Dallwitz, Gen. Leg.–Caesalp. (1983) 55. — Type species: *Sympetalandra borneensis* Stapf.

Trees buttressed. *Stipules* minute, caducous. *Leaves* once-pinnate and (1-) 2- (or 3-) jugate, or bipinnate with 1–3 pairs of pinnae, each pinna with 1–6-pairs of leaflets. *Leaflets* opposite or subopposite, pellucid-punctate. *Inflorescences* axillary and/or terminal, racemose, simple or fascicled, or paniculate; bracts persistent beyond anthesis; bracteoles absent at anthesis. *Flowers* bisexual, calyx and corolla pellucid-glandular. *Hypanthium* obscure or absent. *Calyx* shortly campanulate, 5-lobed. *Petals* 5, widely imbricate, shortly connate at the base. *Disk* absent, except in one species (*S. schmutzii*). *Stamens* 10, alternatively long and short, free of one another, adnate with petals at the base, glabrous; anthers dorsifixed, introrse, ellipsoid or oblong, with a large, dorsal,

dark brown connective, and a deciduous gland at apex. *Ovary* sessile or stipitate, free, mostly spindle-shaped, hairy, 2–6-ovuled; style tortuous or straight; stigma small. *Pods* becoming distinctly woody, dehiscent and two-valved, compressed, prominently veined, 1–4-seeded. *Seeds* orbicular to broadly ellipsoid, compressed but thick, large (3–3.5 cm in diam.), with a hard-coriaceous testa; 2 massive cotyledons; exalbuminous.

Distribution — Species 5, only known in *Malesia*: Sumatra, Malay Peninsula, Borneo, Philippines, Lesser Sunda Islands (Flores).

Note — The present treatment of *Sympetalandra* was mainly compiled after the comprehensive revision made by Van Steenis as cited above.

KEY TO THE SPECIES

- 1a. Leaves once-pinnate. Floral rachis glabrous. Anthers slightly hairy on the dorsal connective. Ovary 2-ovuled. Pods unknown **1. *S. borneensis***
- b. Leaves bipinnate. Floral rachis pubescent **2**
- 2a. Flowers sessile. Leaves with (1 or) 2 (or 3) pairs of pinnae, each pinna with (3 or) 4 (or 5) pairs of leaflets. Anthers slightly hairy at the apex and base. Ovary c. 4-ovuled. Pods often obovate-oblong, slightly oblique, 10–18 by 3–4.5 cm **2. *S. densiflora***
- b. Flowers pedicelled **3**
- 3a. Leaves with 1 pair of pinnae, each pinna with 1 or 2 pairs of leaflets. Anthers slightly hairy at the apex and base. Ovary 5- or 6-ovuled. Pods more or less straight, 18 by 4 cm **3. *S. hildebrandii***
- b. Leaves with 1–3 pairs of pinnae, each pinna with (2 or) 3–6 pairs of leaflets. Anthers glabrous **4**
- 4a. Pedicels 2.5–3 mm, articulated at the base. Disk 5-crenate. Pods more or less linear, 30(–67) by 5 cm **4. *S. schmutzii***
- b. Pedicels 0.5–1 mm, articulated at the top (after the flower has fallen off leaving a short knob-like stalk). Disk absent. Pods falcate, 15–36 by 3.5–4(–5) cm **5. *S. unijuga***

1. *Sympetalandra borneensis* Stapf

Sympetalandra borneensis Stapf in Hook., Icon. Pl. IV, 8 (1901) t. 2721; Steenis, Blumea 22 (1975) 163. — Type: *Haviland & Hose 1628* (K holo; L, SAR), Sarawak.

Tree up to 25 m high, 25 cm in diam.; buttresses 80 cm high, 90 cm wide, 15 cm thick. *Leaves* (1- or) 2- (or 3-)jugate; petiole 4.5–7 cm and rachis 2.5–3.5 cm, both glabrous. *Leaflets* opposite, coriaceous, elliptic, 6–17 by 3–7 cm. *Inflorescences* densely racemose, axillary and extra-axillary, collected into a panicle towards the tops of the shoots; peduncle 1.5–5 cm and rachis 2.5–9 cm, both glabrous; bracts ovate, c. 1 mm long; pedicels very short, c. 0.3 mm, articulated at the base. *Calyx* c. 1.5 mm long, glabrous outside; lobes triangular or crescent, 0.3–0.5 mm long. *Petals* oblong or slightly

obovate-oblong, 2.5–3.5 by 1.5 mm. *Stamens*: filaments 3–4 mm, glabrous; anthers c. 0.6 mm long, slightly hairy at the upper half of dorsal connective. *Ovary* stipitate (stipe c. 1 mm), 1–1.5 mm long, 2-ovuled; style c. 1.5 mm. *Pods* unknown.

Distribution — *Malesia*: Borneo (Sarawak).

Habitat & Ecology — In forests and edge of the kerangas forest, at low and medium altitudes. Fl. March, April, Sept., Oct.

2. *Sympetalandra densiflora* (Elmer) Steenis

Sympetalandra densiflora (Elmer) Steenis, Blumea 22 (1975) 165. — *Cynometra densiflora* Elmer, Leaflet. Philipp. Bot. 1 (1907) 222. — *Erythrophleum densiflorum* Merr., Philipp. J. Sc., Bot. 4 (1909) 267; *ibid.*, Bot. 5 (1910) 35; Meeuwen, Blumea 18 (1970) 31. — Type: *Elmer 9014* (L iso), Luzon.

Tree 15–20 m high, 40–85 cm in diam. *Leaves* bipinnate, with (1 or) 2 (or 3) pairs of pinnae, each pinna with (3 or) 4 (or 5) pairs of leaflets; petiole 5 cm or longer in larger leaves; petiolule 4 mm. *Leaflets* subcoriaceous, ovate or elliptic, 5–11 by 1.8–4.5 cm; subfalcate and acuminate at apex and rounded at base; nerves 3–5 per side. *Inflorescences* terminal or subterminal, paniculate, up to 30 cm long, branches shortly brown pubescent, densely flowered. *Flowers* sessile. *Calyx* 2.5 mm long, pubescent outside; lobes crescent or triangular, 0.3–0.5 mm long. *Petals* creamy white, oblong, 3–5 by 1.5–2 mm. *Stamens*: filaments 3.5–6 mm; anthers 0.7–1 mm long, slightly hairy at the apex and/or base. *Ovary* stipitate, woolly, c. 4-ovuled; style slender, c. 6 mm; stigma capitate. *Pods* often obovate-oblong, and slightly oblique, 10–18 by 3–4 cm, woody, dehiscent, prominently reticulate-striate with some parallel veins along the sutures, the valves c. 1 mm thick. *Seeds* 1–4, more or less orbicular, c. 3 cm in diam. (immature).

Distribution — *Malesia*: Philippines (Luzon, Samar, Mindanao).

Habitat & Ecology — In forests from lowland up to 500 m altitude. Fl. April, May; fr. July.

3. *Sympetalandra hildebrandii* Steenis

Sympetalandra hildebrandii Steenis, Blumea 22 (1975) 166. — Type: *Kiah SF 31984* (L holo; A, K, LAE, P, PNH, SING, buds only), Malay Peninsula.

Sympetalandra borneensis auct. non Stapf: Whitmore, Mal. For. 32 (1960) 71; in Tree Fl. Malaya 1 (1972) 274, pro specim.

Tree 15 m high. *Leaves* bipinnate, with 1 pair of pinnae, each pinna with 1 or 2 pair(s) of leaflets. *Leaflets* chartaceous, elliptic oblong, 8–15 by 3–6 cm, glabrous, acuminate at the apex; petiolules 0.2–1 cm. *Inflorescences* terminal, paniculate, moderately branched, up to 40 cm long, densely flowered, rachis densely short-pilose; lateral branchlets spiciform, 10–15 cm long; pedicels c. 1 mm, articulated at the base. *Calyx* 2 mm long, loosely puberulous at the base, the lobes crescent, 0.5 mm long, 1 mm wide, ciliate. *Petals* broadly elliptic, 2.5–3 by 1.5–1.75 mm, concave. *Anthers* narrow-oblong, 1.2 mm, slightly hairy at the apex and base. *Ovary* sessile, narrowly ellipsoid, 1.5 mm long, glabrous, 5- or 6-ovuled; style oblique, 0.5 mm; stigma slightly widened, minutely



Fig. 51. *Sympetalandra unijuga* (Airy Shaw) Steenis. a. Flowering branch; b. flower; c. half flower showing pistil with stipitate, hairy ovary. — *Sympetalandra hildebrandii* Steenis. d. Half flower showing pistil with sessile, glabrous ovary; e. anthers, dorsal and ventral views respectively; f. two valves of opened pods (a–c: *P. Sam* SAN 36730a; d, e: *Burgess FRI* 9158; f: *Corner s.n.*, Oct. 1935, SING. Drawing Ding Hou (a–e), J.H. van Os (f).

bilobed. *Pods* more or less straight, 2- or 3-seeded, 18 by 4 cm, contracted between the roundish bulging parts; pericarp hard and woody almost 3 mm thick, dehiscent at least along one suture. — **Fig. 51d-f.**

Distribution — *Malesia*: Malay Peninsula (Pahang, Johore).

Habitat & Ecology — On hill. Fl. April, Oct.

4. *Sympetalandra schmutzii* Steenis

Sympetalandra schmutzii Steenis, Blumea 22 (1975) 167. — Type: *Schmutz 2740* (L. holo), Flores.

Large tree. *Leaves* bipinnate, with 3 or 2 pairs of pinnae, each pinna with 3–6 pairs of leaflets; petiole 7–22 cm, thickened at the base; rachis 6–8 cm; stalk of the pinna 4–10 cm; petiolules thickish, dark, 3–5 mm. *Leaflets* oblong-elliptic, 10–15 by 3.5–6 cm; apex acuminate; base more or less equal- or unequal-sided. *Inflorescences* terminal and axillary, simple racemose or little branched panicles; rachis and bracts appressed puberulous; peduncle 4–6 cm, the rachis up to 20 cm, not thickened; pedicels slender, 2.5–3 mm, articulated at the base. *Flowers* patent, glabrous (except the ovary). *Calyx* c. 1 mm long, glabrous; lobes ovate-triangular, c. 0.8 mm long, acute. *Petals* obovate-oblong, 3–5 by 1.5–2 mm. *Disk* 5-crenate, c. 1 mm high. *Stamens*: filaments 5–8 mm; anthers oblong, c. 0.7 mm long. *Ovary* stipitate (stipe c. 2 mm), spindle-shaped, 1.5 mm long, densely woolly, 3- or 4-ovuled; style straight, 3.5 mm. *Pods* very woody, more or less linear, blunt, c. 30(–67) by 5 cm, the margins almost parallel; valves lengthwise striated by c. 20 prominent ribs, 6–8 mm thick, twisted when dry. *Seeds* roundish to broadly elliptic, 4.5–5.5 by 3–3.5 cm, 1.5 cm thick.

Distribution — *Malesia*: Lesser Sunda Islands (Flores).

Habitat & Ecology — At 400–500 m altitude. Fl. and fr. Sept., Oct.

Uses — The bark is used as fish poison and the seeds are used for primitive illumination purposes.

5. *Sympetalandra unijuga* (Airy Shaw) Steenis

Sympetalandra unijuga (Airy Shaw) Steenis, Blumea 22 (1975) 163. — *Erythrophleum unijugum* Airy Shaw, Kew Bull. (1939) 180. — Type: *Agullana 1780* (K holo; L), Sabah.

Erythrophleum densiflorum auct. non (Elmer) Merr.: Merr., Bibl. Enum. Born. Pl. (1921) 295; Pl. Elmer. Born. (1929) 98.

Sympetalandra borneensis auct. non Stapf: Merr., Pl. Elmer. Born. (1929) 98; Kosterm., Gard. Bull. Sing. 17 (1958) 5, p.p.; Whitmore in Tree Fl. Malaya 1 (1972) 274, p.p., excl. *SF 31984*; Meijer, Field Guide Trees W. Mal. (1974) 197, f. 47; Cockb., Trees Sabah 1 (1976) 183, f. 32.

Serianthes gigalobium Kosterm., Reinwardtia 2 (1953) 357, f. 1. — Type: *Neth. Ind. For. Serv. bb 20030* (BO holo; L), Kalimantan.

Tree up to 30 m high, 50(–70) cm in diam.; buttresses up to 4 m high, extending 1 m from the trunk. *Leaves* bipinnate (some leaves pinnate in juvenile state), with 1 (2 or 3) pair(s) of pinnae, each pinna with (2) 3 or 4 (or 5) pairs of leaflets; petiole 2–5(–8) cm; main rachis 6–10 cm; stalk of pinnae 2–5 cm; rachis of pinnae 6–15(–18) cm. *Leaflets* papyraceous to chartaceous, ovate-oblong to oblong-elliptic, 6–10(–17) by 2–4(–8) cm; acuminate at apex and often oblique, more or less rounded at base; petiolules 3–5

mm. *Inflorescences* racemose and paniculate, up to 10 cm long, the rachis loosely to densely hairy; pedicels 0.5–1 mm, articulated at the top, leaving a short, thick knob after the flower has fallen. *Calyx* not ciliate. *Petals* yellowish white. *Stamens*: filaments 2–6 mm. *Ovary* 3–6-ovuled. *Pods* falcate, 15–36 by 3.5–4(–5) cm, coarsely and prominently reticulate-veined; pericarp woody, c. 2 mm thick. *Seeds* massive, 1–5 developed, the 2 cotyledons large, thick, c. 4 by 2.5 by 2 cm, even larger in 1-seeded pods; testa pink when fresh, dark brown when dry. — **Fig. 51a–c.**

Distribution — *Malesia*: Sumatra (E Coast, Indragiri, Bengkulu), Malay Peninsula (Johore), Borneo (Sabah, Sarawak, Kalimantan), Philippines (Luzon).

Habitat & Ecology — In forests, never in wet places, from lowland up to c. 600 m altitude. Fl. April–June, Sept.; fr. July, Sept.–Nov.

UITTIENTIA

(Ding Hou)

Uittientia Steenis, Bull. Bot. Gard. Buitenzorg III, 17 (1948) 416; Hutch., Gen. Flow. Pl. (1964) 237; Irwin & Barneby in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 101 (as syn. of *Dialium*); Rojo, Unpubl. Thesis Oxford (1982) 99, 248; Watson & Dallwitz, Gen. Leg.–Caesalp. (1983) 58 ('*Uittientia*', as syn. of *Dialium*). — *Dialium* subg. *Uittientia* (Steenis) Steyaert, Reinwardtia 2 (1953) 355. — Type species: *Uittientia modesta* Steenis.

Trees. *Stipules* minute, linear, caducous. *Leaves* 1-foliolate, petiolate, thickened at basal end; petiolules very short, wrinkled. *Inflorescences* axillary, fascicled short thyrses. *Hypanthium* obscure or absent. *Calyx* deeply lobed, lobes 5, narrowly imbricate, deciduous. *Corolla* lobes 5. *Disk* distinct, cushion-like, hairy. *Stamens* 5(–7), all fertile, rarely 1–3 smaller; filaments free; anthers basifixed, uniform, ovoid, dehiscing lengthwise. *Ovary* stipitate, terete or slightly ellipsoid, slightly hairy, 1-ovuled; style filiform, slightly hairy; stigma obscure. *Pods* indehiscent, globose, woody, with a softish pulp around the single subglobular seed; endosperm almost filling the seed; embryo minute, conical.

Distribution — Only 1 species known, in *West Malesia*.

Note — The present genus was reduced to *Dialium* as a subgenus by Steyaert (l.c.). Rojo (l.c.), after a comprehensive study of the genus *Dialium*, excluded the genus *Uittientia* from *Dialium* and reinstated it as a monotypic genus within the same subtribe (i.e. tribe *Cassieae* subtribe *Dialiinae* Irwin & Barneby).

According to Rojo (l.c.: 100) the fruit of *Dialium* "has a thin crustaceous exocarp which is usually hairy and easily crushed or sometimes detached from the adjacent mesocarp," while the fruit of *Uittientia* "does not have a crustaceous exocarp but instead has a thick (c. 4–5 mm) and hard pericarp which when dry is uncrushable by hardest press between two hands." See Rojo's figures 2.18b and 3.1 f/g.

Uittientia modesta Steenis

Uittientia modesta Steenis, Bull. Bot. Gard. Buitenzorg III, 17 (1948) 418. — *Dialium modestum* (Steenis) Steyaert, Reinwardtia 2 (1953) 355. — Type: *Neth. Ind. For. Serv. bb 19274* (BO holo; L), Kalimantan.



Fig. 52. *Uttienia modesta* Steenis. a. Flowering branch; b, c. young and old flowers, with calyx lobes, petals, and 2 or 3 stamens removed, showing disk and pistil; d. calyx lobe; e. petal; f. pod; g. length section of pod (a, b, d, e: *Kostermans 13413A*; c: *Kostermans 5885*; f, g: *Kostermans 13231*). Drawing J. H. van Os.

Tree up to 30(–40) m high and 80(–100) cm in diam.; buttresses up to 5 m high, extending outward 1–2 m. *Leaves* glabrous, petiole 8–20 mm, petiolules very short, 2–5 mm. *Leaflets* chartaceous or subcoriaceous, ovate to ovate-oblong, elliptic or ovate to lanceolate, 7–20 by 3.5–7.5 cm; base obtuse or rounded; apex acuminate; lateral nerves 4–7 per side; veins loosely reticulate, obscure or visible on both surfaces. *Inflorescences* with rachis or branches up to c. 7 cm long, sparsely puberulous; bracts and bracteoles minute, narrowly triangular, acute, deciduous. *Calyx* lobes oblong or ovate, 3.5 by 1.5–2 mm, glabrous except sparsely shortly hairy on the margin. *Corolla* lobes subequally ovate, 4–6 by 2–3 mm, glabrous, distinctly pinnately hairy. *Stamens*: filaments c. 2 mm long. *Pistil* 5–6 mm long; stipe distinct, 2 mm; ovary subglobose or broadly ellipsoid, 1–1.5 mm long; style 2–2.5 mm, stigma indistinct. *Pods* often only one developed from an inflorescence, on a thickened woody stalk (c. 1 cm in diam.), c. 6 cm in diam., with a roughish, somewhat scurfy-granular brown surface, glabrous; pericarp rather hard and thick (4–5 mm). *Seed* one in each pod, subglobose, c. 4 cm in diam. — **Fig. 52.**

Distribution — *Malesia*: Sumatra (Indragiri, Palembang), Borneo (Sabah: Tawau; Kalimantan: W, SE, and mainly E regions).

Habitat & Ecology — Primary forest, often occurring below 100 m, sometimes up to 400(–600) m alt. Fl. April, June, July, Nov.; fr. June, July, Sept., Oct.

Uses — The timber has the same properties and uses as that of *Dialium* species. See Rojo & Alonzo in Soerianegara & Lemmens (eds.), Pl. Res. SE Asia (PROSEA Handb.) 5 (1), Major commercial timbers (1993) 165.

EXOTIC GENERA

(Ding Hou)

Species from a number of genera that do not occur native in *Malesia* are often cultivated as ornamental and/or useful trees or shrubs. In this section the most common ones are keyed out and described.

KEY TO THE EXOTIC GENERA

- 1a. Leaves bipinnate 2
- b. Leaves simply pinnate 5
- 2a. Plants armed with spines or stiff thorns 3
- b. Plants unarmed 4
- 3a. Leaflets not reduced to phyllodes. Petals small, 5–6 mm long. Ovary 2- or 3-ovuled. Pods 2–6 cm long, not constricted between the seeds . **Haematoxylum** (p. 723)
- b. Leaflets reduced to phyllodes. Petals 12–14 mm long. Ovary 6–15-ovuled. Pods 5–15 cm long, often constricted between the seeds **Parkinsonia** (p. 726)
- 4a. Flowers large and showy. Petals 3–7 cm long. Ovary many-ovuled. Pods 30–70 (–80) cm long, dehiscing into 2 valves, 40- (or more-)seeded . **Delonix** (p. 721)
- b. Flowers smaller. Petals less than 3 cm long. Ovary 4-ovuled. Pods 8–17.5 cm long, dehiscing at the apex, 1-seeded **Schizolobium** (p. 728)

- 5a. Leaflets 1 pair per leaf, pellucid-punctate. Pods indehiscent . **Hymenaea** (p. 724)
 b. Leaflets 2 or more pairs per leaf, not pellucid-punctate 6
 6a. Flowers very small. Petals less than 2 cm long. Leaflets 10–18(–21) pairs per leaf.
 Pods indehiscent **Tamarindus** (p. 728)
 b. Flowers large, showy. Petals 2.25–7 cm long 7
 7a. Inflorescences long, lax, hanging racemose, peduncle and the rachis more than 50
 cm, loosely flowered. Petals 5.7–7 cm long. Ovary 4–6-ovuled
 **Amherstia** (p. 717)
 b. Inflorescences short, compact, mostly nodding capitate, peduncle and the rachis
 less than 5 cm, densely flowered. Petals 2.25–5.25 cm long. Ovary many-ovuled
 **Brownea** (p. 718)

AMHERSTIA

Amherstia Wall. in Taylor & Philips, Phil. Mag. n.s. 3 (1828) 233; Pl. As. Rar. 1 (1829) 1, t. 1, 2; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 141; Mabb., Taxon 31 (1982) 67; Watson & Dallwitz, Gen. Leg.—Caesalp. (1983) 8. — Type species: *Amherstia nobilis* Wall.

A monotypic genus.

Note — The genus *Amherstia* has always been cited as being published by Wallich in 1829 ('1830'). However, Mabberley (l.c.) recently found that it was already described earlier, in 1828.

Amherstia nobilis Wall.

Amherstia nobilis Wall. in Taylor & Philips, Phil. Mag. n.s. 3 (1828) 223; Pl. As. Rar. 1 (1829) 1, t. 1 & 2; List (1829) no. 596; Miq., Fl. Ind. Bat. 1, 1 (1855) 87; Koord. & Valetton, Bijdr. Booms. Java 1 (1894) 272; Corner, Wayside Trees, ed. 2, 1 (1952) 378; 2 (1952), t. 78; Backer & Bakf., f., Fl. Java 1 (1964) 530; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 106, f. 24; Mabb., Taxon 31 (1982) 67; K. & S.S. Larsen in Fl. Thailand 4 (1984) 93; Rudd in Fl. Ceylon 7 (1991) 101.

Tree up to 12(–20) m high. *Stipules* foliaceous, lanceolate, 2–4 cm long, caducous. *Leaves* paripinnate, (4–)6–8-jugate, 30–60 cm long; new leaves pendent, developing in tassels, pinkish coppery, then bronze. *Leaflets* opposite or subopposite, oblong-lanceolate or oblong, (7–)14–34 by (4–)5.5–8.5 cm; petiolules 7.5–10 mm. *Inflorescences* terminal, simple, pendulous, racemose, 50–80 cm long, 20–26-flowered; peduncles 12–30 cm; bracts caducous; bracteoles 2, large, enclosing flower bud, opposite, valvate or slightly imbricate, persistent, lanceolate or oblong, (4.5–)8–9 by (1.5–)3–3.75 cm; pedicels red, 6–12 cm. *Hypanthium* red, 3.5–4.5 cm long. *Calyx* lobes 4, petaloid, imbricate, narrow-oblong or -lanceolate, 4.75–5.75 by 1–2.25 cm, often reflexed, curved or coiled, rarely straight at anthesis. *Petals* 5, unequal, red, blotched with a large yellow spot and a reddish violet band; 1 uppermost, obcordate, 5.5–7 by 5–5.5 cm; 2 lateral, cuneiform, 5.5–7 by 1.75–2.25 cm; 2 lowermost, minute, rudimentary, subulate, 6–7 mm long. *Stamens* unequal, fertile, 10 (didelphous) or 9 (mono-

delphous), alternately long and short; 9 filaments united at the lower half into a sheath or slightly tube-like, united parts 2.5–3 cm long; free parts 3.5–5.5 cm (long ones) and c. 0.5 cm (short ones); anthers oblong, versatile, alternately large (or longer) and smaller (or shorter), 4–11 mm long. *Pistil*: free part of stipe 7–10 mm; ovary falcate, compressed, 12–20 mm long, densely hairy, 4–6-ovuled; style filiform, 35–30 mm; stigma small, capitellate. *Pods* woody, oblong, or scimitar-like, flattened, dehiscent, 11–20 by 4–5 cm, 4–6-seeded. *Seeds* transversely ovate-orbicular, much compressed, 1.75–2.5 by 2–2.75 cm, exarillate, exalbuminous.

Distribution — Native of Burma. Introduced and cultivated in *Malesia*: Malay Peninsula, Java, and Papua New Guinea.

Habitat — In Burma growing in lowland forest.

Uses — It is cultivated as an ornamental especially for the large, vermilion-coloured flowers. In Burma the magnificent flowers have been collected and carried daily as offerings to the images of Buddha. See Hooker, Bot. Mag. (1849) t. 4453; Hoola van Nooten, Fl. Fr. Feuil. Java (1863–64) t. 2; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 132.

Corner (1950) mentioned that the tree of *Amherstia* is thought by some to be the loveliest in the world. He also stated: "Nothing appears to be known of the evolution or mechanism of the strange flowers; or why the species should be restricted to Burma."

BROWNEA

Brownea Jacq., Enum. Pl. Carib. 6 (1760) 26 ('*Brownaea*'), nom. & orth. cons.; Cowan & Polhill in Polhill & Raven, Adv. Leg. Syst. 1 (1981) 134; Watson & Dallwitz, Gen. Leg.—Caesalp. (1983) 15. — Type species: *Brownea coccinea* Jacq.

Trees or shrubs. *Stipules* often foliaceous, caducous. *Leaves* paripinnate, 2–15-jugate, new ones lax and often bright pink or purplish. *Leaflets* usually with a gland at the base of midrib beneath. *Inflorescences* terminal or axillary, mostly nodding capitate; bracts usually large and coloured, caducous; bracteoles coloured, conspicuous, connate into a bilobed tube enclosing the flower in bud, persistent beyond anthesis. *Hypanthium* tubular. *Flowers* coloured, showy, bisexual. *Calyx* lobes 4 (or 5), petaloid, more or less regular, imbricate. *Petals* 4 (or 5), clawed, slightly unequal, zygomorphic, imbricate. *Stamens* 10–15, connate at the base or into a short tube, rarely free. *Ovary* stipitate, the stipe adnate to hypanthium, many-ovuled; style filiform, stigma capitate. *Pods* oblong, compressed, coriaceous to woody, dehiscent, when dried often splitting into 2 twisted valves, 1–9-seeded. *Seeds* exalbuminous, non-arillate.

Distribution — Species 25–30, tropical America and West Indies. Several of the species have been widely cultivated in the tropics on account of their beautiful flowers. About 4 or 5 species in cultivation in limited regions of *Malesia* (Sumatra, Malay Peninsula, Java, Philippines and Papua New Guinea). See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 370.

Note — Verdcourt [Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 104] and A.C. Smith [Fl. Vit. Nova 3 (1985) 140] remarked that in the absence of a recent revi-

sion of *Brownea*, the identities of the widely cultivated species of this genus are difficult and confused; cultivated hybrids further complicate identification and it is often not possible to accurately name the plants.

The following four species are more often reported in literature and collected from cultivated trees in limited regions of *Malesia*.

KEY TO THE SPECIES

- 1a. Racemes during anthesis 7–10 cm in diam., the peduncle and rachis 2–2.5 cm. Stipules very short (no data for *B. ariza*), 0.3–0.6 cm. Pedicels 5–11 mm. Stamens 3–4.5 cm. Pods 8–18 by 2.5–4.5 cm 2
- b. Racemes during anthesis 14–20 cm in diam., the peduncle and rachis 3–6 cm. Stipules conspicuous, very long, 7–16.5 cm long. Pedicels 9–13 mm. Stamens 6 cm. Pods 12–24 by 4.5–6 cm 3
- 2a. Peduncle and rachis of the raceme during anthesis c. 2.5 cm; pedicels c. 5 mm. Stamens 3–3.5 cm. Pods rusty velvety **1. *B. ariza*** (or a hybrid?)
- b. Peduncle and rachis of the raceme during anthesis 1–1.5 cm. Pedicels 5–11 mm. Stamens 4–4.5 cm. Pods thinly shortly hairy **2. *B. capitella***
- 3a. Young branchlets densely brown hairy. Petals bright red **3. *B. grandiceps***
- b. Young branchlets glabrous or subglabrous. Petals varying from crimson to cherry-red **4. *B. hybrida***

1. *Brownea ariza* Benth.

Brownea ariza Benth., Pl. Hartw. (1845) 171; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 104, f. 23, ?hybrid.

Tree 6–9(–15) m high; young branchlets pubescent, glabrescent. *Leaves* 5-, 6- (or 7-) jugate. *Leaflets* elliptic-oblong to oblong, rarely ovate, 4.5–11 by 2.5–3.5 cm, the basal ones usually smaller, apex very narrowly acuminate, base obliquely rounded, glabrous on both surfaces. *Inflorescences* 9–10 cm in diam. during anthesis, the peduncle and rachis 2–2.5 cm; bracts broad-obovate, 2.5–4.5 cm long, velvety pubescent outside; bracteoles spathe-shaped, 1.7–2.5 cm long, densely rather stiffly velvety pubescent; pedicels c. 5 mm. *Hypanthium* 9–18 mm. *Calyx* lobes 2 cm long. *Petals* 3.5–4 cm long, orange-red or red. *Stamens* 3–3.5 cm; filaments united at the lower 7–17 mm. *Ovary* c. 10 mm long, the style c. 4 cm. *Pods* 10–18 by 4–4.5 cm, rusty velvety.

Distribution — Native of Colombia.

Habitat & Ecology — In Papua New Guinea on old alluvial soil; altitude c. 30 m. Fl. and fr. July, Sept.

Note — Verdcourt (l.c.) identified a specimen collected from the tree cultivated in the Botanic Garden at Lae as '*Brownea ariza* Benth., Hybrid?' and stated that it differs from the type of that species in having the filaments united at the base for a longer distance (against entirely free in that species); he also remarked that "it is possibly a hybrid with one of the species with much longer staminal tubes."

From the specimens collected at Lac, e.g. *LAE 72341*, in both fl. & fr. (L), the stamens are 3–3.5 cm with their basal 7–17 mm united. They match rather well those collected from trees in the Botanic Garden Bogor, under the name *Brownea capitella* Jacq.

2. *Brownea capitella* Jacq.

Brownea capitella Jacq., *Fragm. Bot.* (1809) 26, t. 18, 19; Koord. & Valetton, *Bijdr. Booms. Java* 1 (1894) 271; Backer & Bakh. f., *Fl. Java* 1 (1964) 531.

Tree up to 6 m high; young branchlets densely shortly hairy. *Stipules* 0.3–0.6 cm long. *Leaves* usually 2–5-jugate, the petiole and rachis 5–16 cm. *Leaflets* ovate-oblong, 3.5–15.5 by 1.5–5.5 cm, apex acuminate, base obliquely rounded, or slightly cordate, glabrous on both surfaces. *Inflorescences* 7–10 cm in diam. during anthesis, the peduncle and rachis 1–1.5 cm; bracteoles 1.75–2.25 cm long, densely pubescent; pedicels 5–11 mm. *Hypanthium* 8–11 mm long. *Calyx* lobes 1.3–2 cm long. *Petals* 2.25–4.75 cm long, red. *Stamens* 4–4.5 cm; filaments united at the lower 15–20 mm. *Ovary* c. 10 mm long, the style 2–4 cm. *Pods* 8–15.5 by 2.5–4 cm, thinly shortly hairy.

Distribution — Native of Venezuela. Cultivated in *Malesia*: Malay Peninsula, Java.

Ecology — Flowering throughout the year, with intervals.

3. *Brownea grandiceps* Jacq.

Brownea grandiceps Jacq., *Collectanea* 3 (1791) 287, t. 22, f. a–i; Backer & Bakh. f., *Fl. Java* 1 (1964) 531.

Tree up to 16 m high; young branchlets densely brown hairy. *Stipules* conspicuous, very long, 7–16 cm long. *Leaves* 2–14-jugate, the petiole and rachis (of lower ones) 25–45 cm. *Leaflets* ovate, ovate-oblong, oblong, or lanceolate, 2.5–19.5 by 1–6 cm, apex acuminate, base cordate, rounded or obtuse, glabrous or hairy on the midrib beneath. *Inflorescences* during anthesis 14–18 cm in diam., the peduncle and rachis 3–4.5 cm; bracteoles 2.25–3 cm long; pedicels 9–13 mm. *Hypanthium* 12–15 mm long. *Calyx* lobes 2–2.7 cm long. *Petals* 4.5–5.25 cm long, bright red. *Stamens* c. 6 cm; filaments united at the lower 12–15 mm. *Ovary* c. 10 mm long, the style 3–4.5 cm. *Pods* 12–24 cm by 4.5–6 cm, densely shortly hairy.

Distribution — Native of Venezuela. Cultivated in Malay Peninsula and Java, and possibly elsewhere in *Malesia*.

Ecology — Flowering throughout the year, with intervals.

4. *Brownea hybrida* Backer

Brownea hybrida Hort. ex Backer ('Hort. Bog.'), *Schoolfl. Java* (1911) 418; Backer & Bakh. f., *Fl. Java* 1 (1964) 531. — Type: Based on trees cultivated in Botanic Garden, Bogor.

Much resembling plants of *B. grandiceps* Jacq. except young branches glabrous or subglabrous, variable as regards size (e.g. stipules 7–16.5 cm long; racemes 14–20 cm in diam. during anthesis, the peduncle and rachis 3–6 cm) and tinge of petals from crimson to cherry-red.

Distribution — This hybrid is of unknown origin and uncertain descent. Cultivated in some places in Sumatra, Java, and the Philippines.

Habitat & Ecology — In lower parts of Java, especially in not too dry regions. Fl. and fr. throughout the year.

Note — Backer (l.c.) described and validly published this hybrid species of uncertain descent. Later he and Bakhuizen van den Brink f. (l.c.) stated that "*B. grandiceps* is probably one of the ancestors."

DELONIX

Delonix Raf., Fl. Tellur. 2 (1836) 92; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 92; Watson & Dallwitz, Gen. Leg.—Caesalp. (1983) 23. — Type species: *Delonix regia* (Bojer ex Hook.) Raf.

Trees unarmed. *Leaves* bipinnate. *Leaflets* numerous, opposite. *Inflorescences* axillary, racemose, aggregated near the ends of the branchlets; bracts small, inconspicuous, deciduous or persistent. *Flowers* large, showy, bisexual. *Sepals* 5, valvate. *Petals* 5, obovate, transversely elliptic or reniform, conspicuously clawed. *Stamens* 10, fertile, exserted; filaments pubescent or tomentose below; anthers dorsifixed, longitudinally dehiscing. *Ovary* shortly stipitate, pubescent to glabrous, many-ovuled; style about equaling the length of stamens. *Pods* linear-oblong, flattened, dehiscing into 2 woody or leathery valves, many-seeded. *Seeds* transverse, hard, oblong-subcylindrical to oblong-elliptic.

Distribution — Species 10, from E Africa through Arabia to India, most of the species occurring in Madagascar. One species, with magnificent scarlet flowers, is widely cultivated throughout the Tropics.

Delonix regia (Hook.) Raf.

Delonix regia (Bojer ex Hook.) Raf., Fl. Tell. 2 (1837) 92; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 544; Backer & Bakh. f., Fl. Java 1 (1964) 544; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 30, f. 5; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 65; in Fl. Thailand 4 (1984) 83; A.C. Smith, Fl. Vit. Nova 3 (1985) 90; Rudd in Fl. Ceylon 7 (1991) 104. — *Poinciana regia* Bojer ex Hook., Bot. Mag. 56 (1829) sub f. 2884.

Tree, deciduous, up to 10(–15 or more) m high. *Stipules* pinnately 4- or 5-lobed. *Leaves*: main rachis 50–60 cm long; pinnae 9–20(–25) pairs, rachises up to 10 cm long. *Leaflets* 10–25(–40) opposite pairs per pinna, subsessile or sessile, elliptic or oblong, 5–10(–15) by 2–5 mm; rounded but mucronate at apex, slightly oblique at base; finely puberulous or glabrescent. *Inflorescences* up to 15 cm long, glabrous, 5–10-flowered; pedicels 5–8 cm. *Hypanthium* shortly campanulate. *Sepals* oblong, 4–7 by 2–2.5 mm, acuminate, reddish on inner side. *Petals* unequal, total length 3–7 cm long, the blade orbicular (3–4 cm wide) and narrowed into a claw (up to 3 cm long), one yellowish white and scarlet, the others scarlet. *Stamens* equal in length; filaments up to 4 cm, red with white base; anthers oblong, c. 4 mm long. *Ovary* green, slightly



Fig. 53. *Delonix regia* (Bojer ex Hook.) Raf. Flowering branch. Photograph of a water-colour drawn by H.W. Groll in 1892, after Th. Rocke. Original plate in Leiden; photograph B. Kieft, $\times 0.43$.

velutinous; style glabrous, 2.5 cm; stigma indistinct. *Pods* oblong, flat, slightly curved, 30–70(–80) by 3.5–5(–7) cm, blackish, beaked. *Seeds* narrowly oblong-elliptic, compressed, up to 2.5 by 0.8 cm. — **Fig. 53.**

Distribution — A rare plant native of Madagascar, cultivated throughout the tropics for the magnificent flowers.

Common names — Flamboyant, Flame tree, Royal Poinciana.

HAEMATOTOXYLUM

Haematoxylum L., Sp. Pl. (1753) 384; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 93; Watson & Dallwitz, Gen. Leg.-Caesalp. (1983) 31. — Type species: *Haematoxylum campechianum* L.

Tree or *shrub*, sometimes with spiny branchlets. *Stipules* caducous. *Leaves* spiral, paripinnate or partially bipinnate. *Leaflets* few pairs per leaf. *Inflorescences* crowded on short shoots, axillary, terminal, racemose. *Flowers* small, bisexual; bracts minute, absent at anthesis; bracteoles none. *Hypanthium* short. *Calyx* covering the rest of the flower in bud, slightly unequal, 5-lobed, lobes imbricate, soon deciduous. *Petals* 5, imbricate, subequal. *Stamens* 10, fertile, free; filaments pilose at base; anthers introrse. *Ovary* shortly stipitate, free, 2- or 3-ovuled; style filiform; stigma small, terminal. *Pods* lanceolate or elliptic-oblong, compressed, two-valved, valves thin. *Seeds* transversely oblong, exalbuminous.

Distribution — Tropical America and SW Africa. Three species, one of them cultivated in *Malesia*.

Haematoxylum campechianum L.

Haematoxylum campechianum L., Sp. Pl. (1753) 384; Miq., Fl. Ind. Bat. 1, 1 (1855) 115; Koord. & Valeton, Bijdr. Booms. Java 1 (1894) 270; Backer & Bakh. f., Fl. Java 1 (1964) 543.

Tree up to c. 15 m high. *Leaves* with one spine in the axil, 3–5-jugate, petiole with rachis up to c. 10 cm. *Leaflets* subsessile, opposite, obovate, 2–3 by 1–2.5 cm, emarginate or subtruncate at apex, cuneate at base, glabrous; nerves and veins fine. *Inflorescences* up to 6(–12) cm long, rather densely flowered; pedicels 4–6 mm. *Flowers* fragrant. *Calyx* lobes yellow or purple-tinged, ovate, 3–4 mm long. *Petals* bright yellow, obovate, 5–6 mm. *Stamens* almost the same length as petals. *Ovary* and style pubescent. *Pods* 2–6 by 0.8–1.2 cm.

Distribution — Tropical America, now widely cultivated in the Tropics.

Common names — Logwood (English), Bois de campêche (French).

Uses — The heartwood and roots are the source of blue, violet, and purple dyes used for ink, and for dyeing woollen and silk goods. The heartwood is also the source of a red dye (haematoxylin) which is used as a stain in histological work. See Burkill, Dict. Econ. Prod. Malay Penins. (1938) 1142; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 749; Seegeler in Lemmens & Wulijarni-Soetjipto (eds.), Pl. Res. SE Asia (PROSEA Handb.) 3, Dye & tannin-producing plants (1991), 78, f. 1, 2.

HYMENAEA

Hymenaea L., Sp. Pl. (1753) 1192; Lee & Langenheim, Univ. Calif. Publ. Bot. 69 (1975) 51; Cowan & Polhill in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 130; Watson & Dallwitz, Gen. Leg.—Caesalp. 1 (1983) 34. — Type species: *Hymenaea courbaril* L.

Trachylobium Hayne, Flora 10 (1827) 743; Hutch., Gen. Pl. 1 (1964) 243; Brenan, Fl. Trop. E Afr., Caesalp. (1967) 132. — Type species: *Trachylobium verrucosum* (Gaertn.) Oliv. (= *Hymenaea verrucosa* Gaertn.).

Trees. *Stipules* caducous. *Leaves* bifoliate, petiolate. *Leaflets* pellucid-punctate. *Inflorescences* terminal, paniculate or corymbose-paniculate; bracts and bracteoles caducous. *Flowers* pedicelled, all parts pellucid-punctate. *Hypanthium* narrowly campanulate. *Calyx* lobes 4, imbricate. *Petals* 5, subequal, slightly zygomorphic, imbricate. *Disk* absent. *Stamens* 10, free, exserted; filaments folded in bud, more or less equal in length; anthers dorsifixed and versatile, longitudinally dehiscent. *Ovary* stipitate, excentric with adnate stipe, 3–15- (or more-)ovuled. *Pods* indehiscent, woody, 3–8- (or more-)seeded. *Seeds* non-arillate, exalbuminous.

Distribution — A genus consisting of 14 species (including their varieties) (fide Lee & Langenheim, l.c.): 13 in Mexico, West Indies, and tropical South America; only one of them occurring in E tropical Africa, Madagascar, Mauritius, and the Seychelles. The following two species are cultivated in *Malesia*.

Uses — Producing commercially valuable gum-resins or copals and to a limited extent for medicinal purposes. The resin is also used in varnishes. The pulpy (endocarp) tissue surrounding the seeds is edible. See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1235; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 730.

KEY TO THE SPECIES

- a. Inflorescences short, corymbose-paniculate, 8–15 cm long. Flowers often large, old buds up to 35 mm long. Petals not clawed, almost equal in shape and size. Pods surface smooth or rough, not rugose **1. *H. courbaril***
- b. Inflorescences long, paniculate, up to 35 cm long or longer. Flowers small, old buds often less than 15 mm long. Petals distinctly clawed, often not equal in shape and size. Pods surface coarsely verrucose-rugose **2. *H. verrucosa***

1. *Hymenaea courbaril* L.

Hymenaea courbaril L., Sp. Pl. (1753) 1192; Backer & Bakh. f., Fl. Java 1 (1964) 528; Lee & Langenheim, Univ. Calif. Publ. Bot. 69 (1975) 79, f. 25–27; Wei in Fl. Reipubl. Popul. Sin. 39 (1988) 212, t. 74/1–4; Rudd in Fl. Ceylon 7 (1991) 1056.

This polymorphic, tropical American species consists of six varieties. Five of them are found so far only in Brazil but one has a wider range, is cultivated in the tropics and is treated here.

var. **courbaril**

Lee & Langenheim, Univ. Calif. Publ. Bot. 69 (1975) 80, f. 25, 26.

Tree up to 25(–40) m tall, often much smaller in cultivation, branchlets glabrous. *Leaves* short petioled, petiole 10–20 mm; petiolules twisted, very short, 2–4 mm. *Leaflets* coriaceous, falcate to broadly falcate, rarely oblong or obovate, 4–10 by 2–5 cm, glabrous; apex shortly acuminate, obtuse, rarely retuse; base asymmetric. *Inflorescences* shortly, densely corymbose-paniculate; pedicels c. 6 mm. *Hypanthium* c. 6 mm long. *Calyx* lobes 4, coriaceous, ovate to elliptic, 15–18 by 8 mm, pubescent outside, sericeous inside. *Petals* yellow, streaked with red, subsessile, oblong, ovate or obovate, more or less equalling the calyx lobes or slightly longer. *Stamens* 3–3.5 cm. *Ovary* stipitate (stipe 4–8 mm), c. 4 by 2 mm, glabrous, 12–15- (or more-)ovuled. *Pods* oblong or cylindric, compressed, 8–14(–20) by 4–6(–8) cm, smooth or rough, dark brown, 6–12- (or more-)seeded. *Seeds* oblong, obovoid, or ellipsoid, 2–3 cm long.

Distribution — Native to the American tropics, widely distributed from southern Mexico and the West Indies to Brazil. Cultivated in the tropics, also in *Malesia*: seen from Malay Peninsula, Borneo (Sabah), Java.

Uses — See under the genus.

2. *Hymenaea verrucosa* Gaertn.

Hymenaea verrucosa Gaertn., Fruct. 2 (1791) 206, t. 139, f. 7; Lee & Langenheim, Univ. Calif. Publ. Bot. 69 (1975) 54, f. 11; Wei in Fl. Reipubl. Popul. Sin. 39 (1988) 212, t. 74/5–7; Rudd in Fl. Ceylon 7 (1991) 106. — *Trachylobium verrucosum* (Gaertn.) Oliv., Fl. Trop. Afr. 2 (1871) 311; Backer & Bakh. f., Fl. Java 1 (1964) 528; Brenan, Fl. Trop. E. Afr., Caesalp. (1967) 134, f. 25.

Tree up to 24(–40) m tall. *Stipules* narrowly elliptic, c. 20 by 4–6 mm. *Leaf* petiole 8–18 mm; petiolules twisted, 3–5 mm. *Leaflets* coriaceous, ovate to elliptic, oblong-elliptic, or broadly falcate, 3.5–12.5 by 2–7 cm; apex obtusely pointed to shortly acuminate; base asymmetric, oblique, more or less obtuse or rounded; glabrous or subglabrous on both surfaces. *Inflorescences* paniculate, up to 35 cm long, often much shorter and few-flowered, branchlets and pedicels densely and shortly pubescent; bracts and bracteoles ovate or orbicular; pedicels 2–9 mm, articulate at base. *Flowers* small, white. *Hypanthium* 1.5–2 mm long. *Calyx* lobes ovate, 7–11 by 4–6 mm, densely appressed, puberulous outside, silvery sericeous inside. *Petals* clawed and subequal, the larger ones 15–20 mm long (incl. the narrowly linear claw), limb broadly ovate or suborbiculate, 8–10 mm in diam., sometimes 2 petals minute and scale-like. *Stamens* unequal, up to c. 25 mm. *Ovary* slightly stipitate, densely hirsute at base, more or less glabrous above, 4-ovuled. *Pods* ovoid-oblong, ellipsoid-oblong, or obovoid, 2.5–5 by 1.5–3 cm, coarsely verrucose-rugose, reddish to dark brown, resiniferous, 1–3-seeded. *Seeds* ellipsoid, 13–18 by 9–12 mm, dark brown.

Distribution — Native to the coast of eastern Africa, the islands of Zanzibar, E coast of Madagascar, Seychelles, and Mauritius. Introduced and planted in tropical gardens, in *Malesia* seen from Borneo (Sabah) and Java.

Uses — See under the genus.

PARKINSONIA

Parkinsonia L., Sp. Pl. (1753) 375; Polhill & J.E. Vidal in Polhill & Raven (eds.), Adv. Leg. Syst. 1 (1981) 94; Watson & Dallwitz, Gen. Leg.—Caesalp. (1983) 46. — Type species: *Parkinsonia aculeata* L.

Trees or shrubs, armed; branches slender, often pendent. *Stipules* spinescent, persistent or caducous. *Leaves* crowded on short shoots, spiral, bipinnate, 2 (4, or 6) opposite pinnae, the rachis of pinnae elongate, flattened, phyllodial. *Leaflets* small, numerous, along margins of pinnae, opposite or subopposite, caducous. *Inflorescences* of racemose units, crowded on short shoots; bracts and bracteoles absent or absent at anthesis. *Flowers* perfect, showy, fragrant. *Hypanthium* very short, obliquely campanulate. *Calyx* 5-lobed, lobes equal, deciduous. *Petals* 5, slightly zygomorphic or very zygomorphic, imbricate, clawed. *Stamens* 10, more or less equal or unequal in length, free, fertile; anthers introrsely or longitudinally dehiscent. *Ovary* stipitate, free, 6–15-ovuled; style filiform; stigma minute. *Pods* pendent, often externally constricted between the seeds, dehiscent, 1–10-seeded. *Seeds* albuminous.

Distribution — Monotypic or consisting of 11–15 species, depending on the interpretation of generic limits; native of tropical and subtropical America and S Africa. One species cultivated in *Malesia*.

Note — For recent reviews about the generic delimitation and bibliography of *Parkinsonia*, see the papers by e.g. Isely [Mem. N.Y. Bot. Gard. 25 (1975) 169], Robertson & Lee [J. Arnold Arbor. 57 (1976) 32], and Gunn [Techn. Bull. U.S.D.A. 1755 (1991) 114]. The generic description given above applies mainly or only to *Parkinsonia aculeata*.

Parkinsonia aculeata L.

Parkinsonia aculeata L., Sp. Pl. 1 (1753) 375; Miq., Anal. Bot. Ind. (1850) 9; Fl. Ind. Bat. 1, 1 (1855) 115; Koord. & Valetton, Bijdr. Booms. Java 1 (1894) 271; Backer & Bakh.f., Fl. Java 1 (1964) 542; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 67; in Fl. Thailand 4 (1984) 49; H.C. Cheng in Fl. Reipubl. Popul. Sin. 39 (1988) 117, t. 39; Gunn, Techn. Bull. U.S.D.A. 1755 (1991) 114, f. A, L–M.

Shrub or small *tree*, 3–4 m tall; young shoots zigzag, glabrous, stiff thorns up to 3 cm long. *Stipules* 2, forming short spines. *Leaf* petiole and rachis rather short, up to c. 2 cm long; pinnae with rachis up to 25(–40) cm long. *Leaflets* numerous, very small, obovate, oblong, 2–5(–8.5) by 1–1.5(–3.5) mm. *Inflorescences* up to 20 cm long; pedicels up to 10(–15) mm, articulated below the glabrous flower. *Calyx* lobes ovate-oblong, 5–7 mm long, glabrous, reflexed. *Petals* very thin, golden yellow, spoon-shaped with the limb suborbicular or broadly ovate (c. 7 mm wide) and the claw hairy, 12–14 mm long. *Stamens* shorter than the petals; filaments hairy in the lower half, widened towards the base; anthers ellipsoid, dehiscing longitudinally. *Ovary* subsessile, hairy; style glabrous; stigma obscure. *Pods* cylindric, 5–15 by c. 0.7 cm, glabrous, yellowish. *Seeds* oblong, c. 10 by 4 mm, slightly compressed.



Fig. 54. *Schizolobium parahybum* (Vell.) Blake. Flowering branch. Photograph of a water-colour by unknown artist. Original plate in Leiden; photograph B. Kieft, $\times 0.37$. Floral parts and pods in pencil, obscure in print.

Distribution — Native of tropical America. Widely cultivated all over the tropics, commonly known as 'Jerusalem Thorn'. In *Malesia* cultivated and occasionally naturalized.

Uses — Ornamental. Bark and leaves used for medicinal purposes.

SCHIZOLOBIUM

Schizolobium Vogel, *Linnaea* 11 (1837) 399; Polhill & J.E. Vidal in Polhill & Raven (eds.), *Adv. Leg. Syst.* 1 (1981) 90; Watson & Dallwitz, *Gen. Leg.—Caesalp.* (1983) 51. — Type species: *Schizolobium excelsum* Vogel [= *Schizolobium parahybum* (Vell.) Blake].

Trees. *Stipules* caducous. *Leaves* spiral, bipinnate; pinnae opposite or subopposite. *Leaflets* petiolulate, opposite or subopposite. *Inflorescences* axillary or terminal, simple racemose, or paniculate of racemose units; bracts and bractoles caducous. *Hypanthium* present. *Calyx* 5-lobed, lobes more or less regular or zygomorphic, imbricated. *Petals* 5, imbricate, clawed. *Stamens* 10, free, all or 9 fertile; anthers dehiscent introrsely or longitudinally. *Ovary* stipitate, excentric with adnate stipe, 4-ovuled; style filiform; stigma obscure. *Pods* one-seeded, opening at apex. *Seeds* albuminous.

Distribution — One or two species, native in C America to Brazil. Cultivated in *Malesia*.

Schizolobium parahybum (Vell.) Blake

Schizolobium parahybum (Vell.) Blake, *Contr. U.S. Nat. Herb.* 20 (1919) 240. — *Cassia parahyba* Vell., *Fl. Flum.* (1825) 168; *Icon.* 4 (1827) t. 71.

Schizolobium excelsum Vogel, *Linnaea* 11 (1837) 399; Koord. & Valetton, *Bijdr. Booms. Java* 1 (1894) 268; Backer & Bakh. f., *Fl. Java* 1 (1964) 542.

Tree up to 40 m high. *Leaves* with 15–26 pairs of pinnae; petiole and main rachis up to c. 2 m; pinnae up to 30 cm, 8–27 pairs of leaflets per pinna. *Leaflets* short petiolulate, oblong, 1.5–3.5 by 0.5–1.5 cm, glabrous above, appressed-pubescent beneath. *Inflorescences* up to 90 cm long; pedicels 10–17 mm, articulated near the middle. *Flower buds* puberulous outside. *Hypanthium* 6–10 mm long. *Calyx* lobes 9–11 mm long. *Petals* patulate; limb corrugate, bright yellow, ovate-oblong or obovate, 17.5–22.5 mm long and wide; claw 4–7 mm long. *Stamens* slightly unequal, shorter than the petals; filaments villous below. *Ovary* densely hairy; style glabrous. *Pods* obliquely erect, obovate, 8–17 by 3–5 cm, rounded at apex, cuneate towards base, glabrous, rugose. — **Fig. 54.**

Distribution — Central America to Brazil.

Uses — In *Malesia* cultivated as an ornamental: seen from Sumatra, Java, Philippines.

TAMARINDUS

Tamarindus L., *Sp. Pl.* (1753) 34; *Gen. Pl.*, ed. 5 (1754) 20; Cowan & Polhill in Polhill & Raven (eds.), *Adv. Leg. Syst.* 1 (1981) 141; Watson & Dallwitz, *Gen. Leg.—Caesalp.* (1983) 56. — Type species: *Tamarindus indica* L.

A monotypic genus.



Fig. 55. *Tamarindus indica* L. Habit. Photograph of a water-colour by unknown artist. Original plate in Leiden; photograph B. Kieft, $\times 0.4$.

***Tamarindus indica* L.**

Tamarindus indica L., Sp. Pl. (1753) 34; Backer & Bakh. f., Fl. Java 1 (1964) 529; Brenan., Fl. Trop. E. Afr., Caesalp. (1967) 153, f. 32; Robertson & Lee, J. Arnold Arbor. 57 (1976) 47; Verdc., Manual New Guinea Leg., Lae Bot. Bull. 11 (1979) 108, f. 25; K. & S.S. Larsen in Fl. Camb., Laos & Vietnam 18 (1980) 145, pl. 25/10–12; in Fl. Thailand 4 (1984) 124, f. 31/10–12; A.C. Smith, Fl. Vit. Nova 3 (1985) 141; Wei in Fl. Reipubl. Popul. Sin. 39 (1988) 217, t. 76.

Tree up to 24 m high; young branchlets pubescent, glabrescent. *Stipules* minute, free, caducous. *Leaves* spiral, 10–18(–21)-jugate, petiole and rachis 5–12(–16) cm long, slightly pubescent, glabrescent. *Leaflets* sessile or subsessile, opposite or subopposite, narrowly oblong, 8–30 by 3–10 mm, unequal, rounded or slightly mucronate at the apex, rounded at the base, glabrous or slightly puberulous, venation reticulate. *Inflorescences* terminal and lateral racemes, up to 15(–22) cm long, the rachis puberulous, glabrescent, loosely flowered; bracts and bracteoles ovate-oblong, 5 by 3 mm, caducous; pedicels up to 14 mm, puberulous, glabrescent. *Hypanthium* narrowly turbinate, 4–4.5

mm long. *Sepals* 4, reddish outside, yellow inside, zygomorphic, imbricate, oblong-elliptic, 8–12 by 5 mm, slightly puberulous at the base. *Petals* 5, yellow or cream with red veins, very zygomorphic, upper 3 well-developed, lower 2 reduced, elliptic or obovate-elliptic, 10–13 by 2–6 mm. *Stamens* less than 10, up to 15 mm; filaments connate for about half their length into a pubescent tube; 3 fertile ones with anthers oblong, longitudinally dehiscent; staminodes 4 or 5, tooth-like, alternating with the fertile ones. *Ovary* stipitate, linear, c. 7 mm long, pubescent, 8–14-ovuled; style elongate, 7 mm, pubescent; stigma subcapitate. *Pods* indehiscent, oblong, slightly curved or straight, 5–15 by 2–3 cm, scurfy, with acid pulpy part, up to c. 10-seeded. *Seeds* obovate-orbicular, 11–17 by 10–12 mm, compressed, glossy, dark brown, non arillate, exalbuminous. — **Fig. 55.**

Distribution — Perhaps indigenous in Africa. Widely cultivated all over the tropics.

Uses — The acid pulpy part of the pods is used for various preserves, jams, sweets and beverages. Seeds are edible and also used as vermicide. See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 2159; K. Heyne, Nutt. Pl. Indon., ed. 3 (1950) 730; Coronel in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Hand.) 2, Edible fruits and nuts (1991) 298–301.

Note — This widely cultivated plant is commonly known as 'tamarind'. The generic name is derived from Arabic *tammarhindi* (i.e. Indian date).

GEITONOPLESACEAE

(Joseph E. Laferrière, Tucson, U.S.A.)¹

Geitonoplesiaceae [R. Dahlgren, Bot. J. Linn. Soc. 80 (1980) 98, nom. nud. ex] Conran, *Telopea* 6 (1994) 39.

Glabrous, hermaphroditic, perennial, much-branched leafy *climbers* or *subshrubs* up to 5 m tall. Stems woody below, thin and flexuous above, green, much branched, twining, terete to compressed. *Leaves* alternate, distichous, with a prominent to obscure midrib, sessile or with a short petiole, sometimes sheathing at the base, lanceolate to ovate or sometimes linear; veins numerous, parallel with few or no cross veins; midrib prominent; spines and stipules lacking; leaves reduced to scales under each branch. *Inflorescence* an axillary fascicle or a loose terminal cyme or panicle; pedicel articulate immediately under the flower. *Flowers* small, perfect, actinomorphic, campanulate, hypogynous, often pendulous. *Perianth* segments 6, oblong, spreading, equal in length, white or greenish to pink or pale violet, free almost to the base or fused, often prolonged at the base into a pericladium, nectariferous at the base, corona absent. *Sepals* firm, valvate in bud, shortly hood-shaped at apex. *Petals* flat, obtuse, slightly imbricate, the margins thin and entire. *Stamens* 6, in two whorls, hypogynous, not exceeding the perianth; filaments free or fused at the base; anthers oblong-linear, bilocular, basifixed, introrse, sagittate at base, erect, yellow, poricidal. *Ovary* superior, trilocular with axile placentae; ovules few, anatropous or campylotropous, crassinucellate; style filiform; stigma punctate. *Fruit* a berry or capsule. *Seeds* several, rounded to angular-crescentic, black, shiny, sometimes strophiolate; endosperm copious, lacking starch; embryo linear.

DISTRIBUTION

Two genera, each with one species, both occurring in *Malesia*.

TAXONOMY

Dahlgren et al. (1985) placed both genera, plus *Luzuriaga*, *Behnia* and *Elachanthera*, in the *Luzuriagaceae*, separate from the *Philesiaceae*, whereas Dahlgren & Clifford (1982) included them in the *Philesiaceae*. Cronquist (1981) put them in the *Smilacaceae*. More recent cladistic and phenetic evidence suggests that, while *Eustrephus* and *Geitonoplesium* are closely related to each other, they are only distantly related to *Luzuriaga* and *Philesia* (Conran 1987a). Their closest relatives appear to be in the *Phormiaceae* (Conran 1989). The two genera are here treated in the separate family *Geitonoplesiaceae*. Both species are highly variable. Several synonyms and infraspecific taxa have been proposed, although none is here accepted (Schlittler 1951; Conran 1987b; Laferrière 1995).

1) With a contribution on palynology by R.W.J.M. van der Ham, Leiden. Drawings by J.G. Conran, Adelaide, reproduced with permission from *Flora of Australia* 46.

References: Conran, J.G., Taxon 34 (1985) 346–347. — Conran, J.G., Austral. J. Bot. 35 (1987a) 283–300. — Conran, J.G., Muelleria 6 (1987b) 363–369. — Conran, J.G., Pl. Syst. Evol. 168 (1989) 123–141. — Conran, J.G., Telopea 6 (1994) 39–41. — Cronquist, A., An integrated system of classification of flowering plants (1981). — Dahlgren, R.M.T. & H.T. Clifford, The monocotyledons: a comparative study (1982). — Dahlgren, R.M.T., H.T. Clifford & P.F. Yeo, The families of the Monocotyledons: structure, evolution, and taxonomy (1985). — Laferrière, J.E., Austrobaileya 4 (1995) 391–399. — Schlittler, J., Ber. Schweiz. Bot. Ges. 61 (1951) 175–239.

PALYNOLOGY

(R.W.J.M. van der Ham)

Eustrephus and *Geitonoplesium* have different pollen types (Schulze 1982). Pollen of *Eustrephus* is monocolpate, elliptic in polar view, and measures 40–(47)–52 × 29–(32)–35 µm. Radulescu (1973) gives larger sizes: 53–62 × 31–41 µm. The colpus ends extend slightly on the proximal side of the pollen grain. Exine thickness is 1–1.5 µm. The sexine, which consists of a tectum and a columellate infratectal layer, is slightly thicker than the nexine. The ornamentation is microreticulate all-over. The diameter of the lumina (< 1 µm) decreases towards the aperture.

Pollen of *Geitonoplesium* is trichotomocolpate, obtusely triangular with convex sides in polar view, oblate (P/E = c. 0.67), and measures 23–(26)–33 µm in equatorial diameter. The ends of the three-armed colpus reach the proximal side. Exine thickness is c. 1 µm. The ornamentation is microreticulate (diameter lumina < 1 µm). Along with several trichotomocolpate collections Erdtman (1952) describes a deviating pollen sample from New Caledonia (*Franc* 627; “determination confirmed by Skottsberg”) as monocolpate, 49 × 36 µm, which reminds much of *Eustrephus* pollen.

Monocolpate pollen is common in the *Asparagales* (sensu Dahlgren & Clifford 1982). Trichotomocolpate pollen occurs (see also Schulze 1982) in the *Asphodelaceae* (subfam. *Anthericoideae*: 9 genera), *Dianellaceae* (*Dianella*: also tetrachotomocolpate; *Stypandra*), *Doryanthaceae* (*Doryanthes*: rarely; *Herpolirion*) and *Phormiaceae* (*Phormium*).

References: Erdtman, G., Pollen morphology and plant taxonomy (1952). — Dahlgren, R.M.T. & H.T. Clifford, The monocotyledons: a comparative study (1982). — Radulescu, D., Acta Bot. Hort. Bucurest. 1972–1973 (1973) 133–248. — Schulze, W., Wiss. Zeitschr. Friedrich-Schiller-Univ. Jena, Mat.-Nat. R. 31 (1982) 277–283, 291–307.

KEY TO THE GENERA

- a. Flowers in axillary clusters arising from a globose to oblong cluster of imbricate scales; petals ciliate; filaments broad, flat, fused; roots often tuberous; fruit orange, dehiscent ***Eustrephus*** (p. 000)
- b. Flowers in terminal cymes or panicles; petal margins entire; filaments filiform, separate; roots fibrous; fruit black, indehiscent ***Geitonoplesium*** (p. 000)

EUSTREPHUS

Eustrephus R.Br. in Ker Gawl., Bot. Mag. 31 (1809) t. 1245. — Type species: *Eustrephus latifolius* R.Br.

Distribution — Only one species; for distribution see there.

***Eustrephus latifolius* R.Br.**

Eustrephus latifolius R.Br. in Ker Gawl., Bot. Mag. 31 (1809) t. 1245; Prodr. Fl. Nov. Holl. (1810) 281; Standley & Ross, Fl. SE Queensl. 3 (1989) 67; Conran & Clifford in Fl. Austral. 46 (1986) 192. — *Luzuriaga latifolia* (Ker Gawl.) Poir., Encycl. Suppl. 3 (1813) 535. — Type: *Brown 5663* (BM), New South Wales.

Eustrephus angustifolius R.Br., Prodr. Fl. Nov. Holl. (1810) 281. — *Eustrephus latifolius* var. *angustifolius* (R.Br.) Benth., Fl. Austral. 7 (1878) 18. — Type: *Brown 5664* (BM), Queensland.

Small shrubs or twining climbers, 1–5 m tall. Roots fusiform, sometimes tuberous. *Leaves* non-resupinate, sessile or nearly so, broadly ovate to lanceolate or narrowly linear, 2–20 by 0.2–5 cm, firm, longitudinally striate-nerved, the apex usually acute, with scarcely distinct costa. *Inflorescence* an axillary cymose bundle with 1–6 flowers; pedicels filiform but rigid, persistent, 5–18 mm long, with an ovate bract at the base, these scarious and imbricate. *Perianth* segments oblong, nearly equal, c. 6 mm long. *Sepals* elliptic-oblong, acute, 7–9-nerved, convex, firm, shortly hood-shaped at the apex. *Petals* elliptic, thinner than sepals, flat, obtuse, bearing yellow or pellucid markings, fimbriate. *Stamens*: filaments short, flat, connate at base; pollen monosulcate. *Fruit* a yellow, globular or rarely pyriform fleshy capsule 0.7–2 cm in diam. *Seeds* 8–12, subspherical to obtusely angled, strophiolate. $2n = 18$ [Stenar, Acta Horti Berg. 16 (1952) 219–232]. — **Fig. 1.**

Distribution — East coast of Australia, New Caledonia; *Malesia*: southern New Guinea. Reported from West Java but probably as an escape from cultivation at the Botanical Garden in Bogor.

Habitat & Ecology — Found on riverbanks, lakeshores, roadsides, thickets, grassy savannas, early secondary forest, and other relatively sunny areas, from sea level to 3000 m altitude.

Uses — Tuberous roots and strophiolate arils used as food by native Australians; use as food not recorded from Malesia.

GEITONOPLESIMUM

Geitonoplesium A.Cunn. ex Hook., Bot. Mag. 59 (1832) t. 3131. — Type species: *Geitonoplesium cymosum* (R.Br.) Hook.

Luzuriaga auct. non Ruiz & Pavón (1802): R.Br., Prodr. Nov. Holl. (1810) 281.

Distribution — Only one species; for distribution see there.

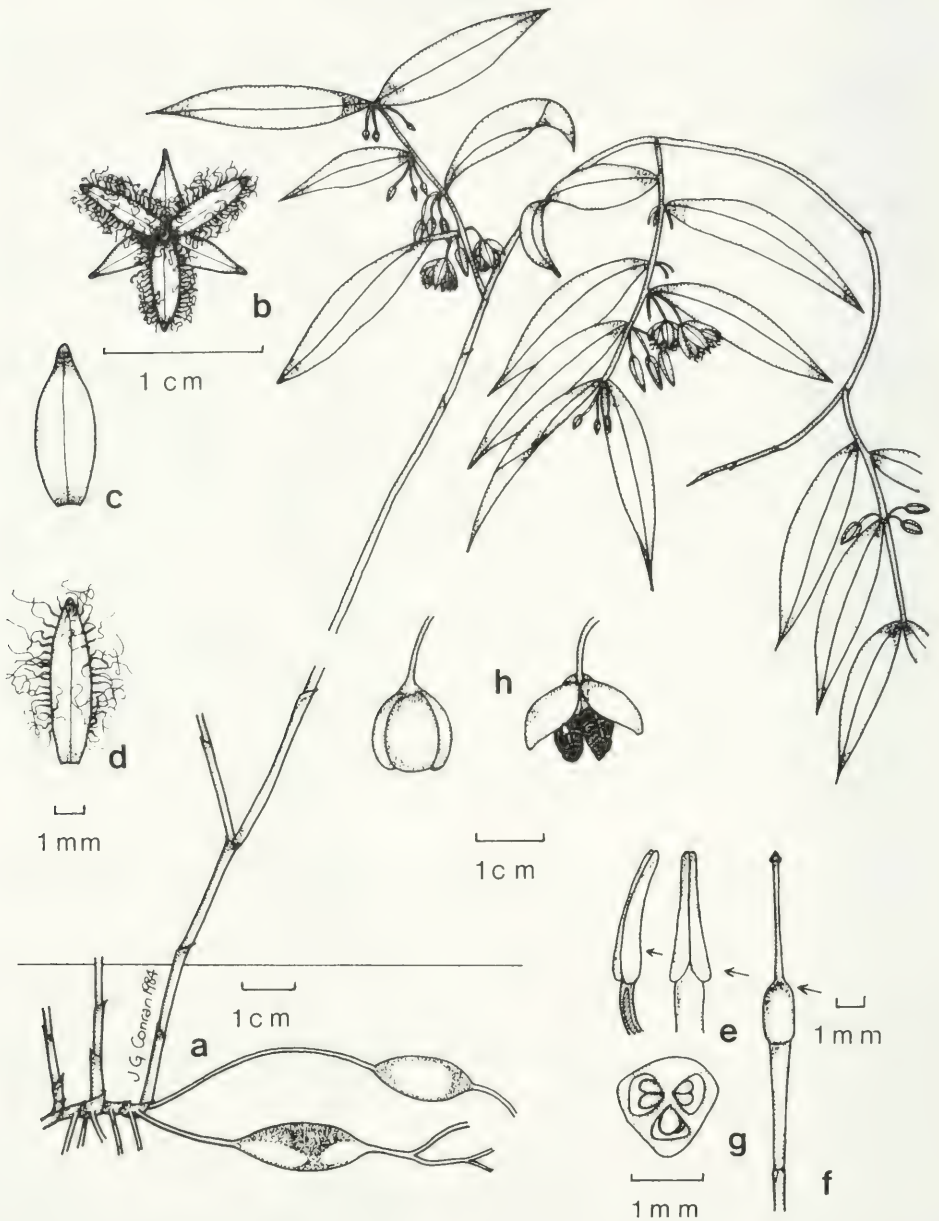


Fig. 1. *Eustrephus latifolius* R.Br. a. Flowering plant; b. flower; c. sepal; d. petal; e. stamen, side and front view, other fused stamens removed; f. pistil; g. ovary, section; h. fruit, closed and open (Conran 112). Drawing J.G. Conran.

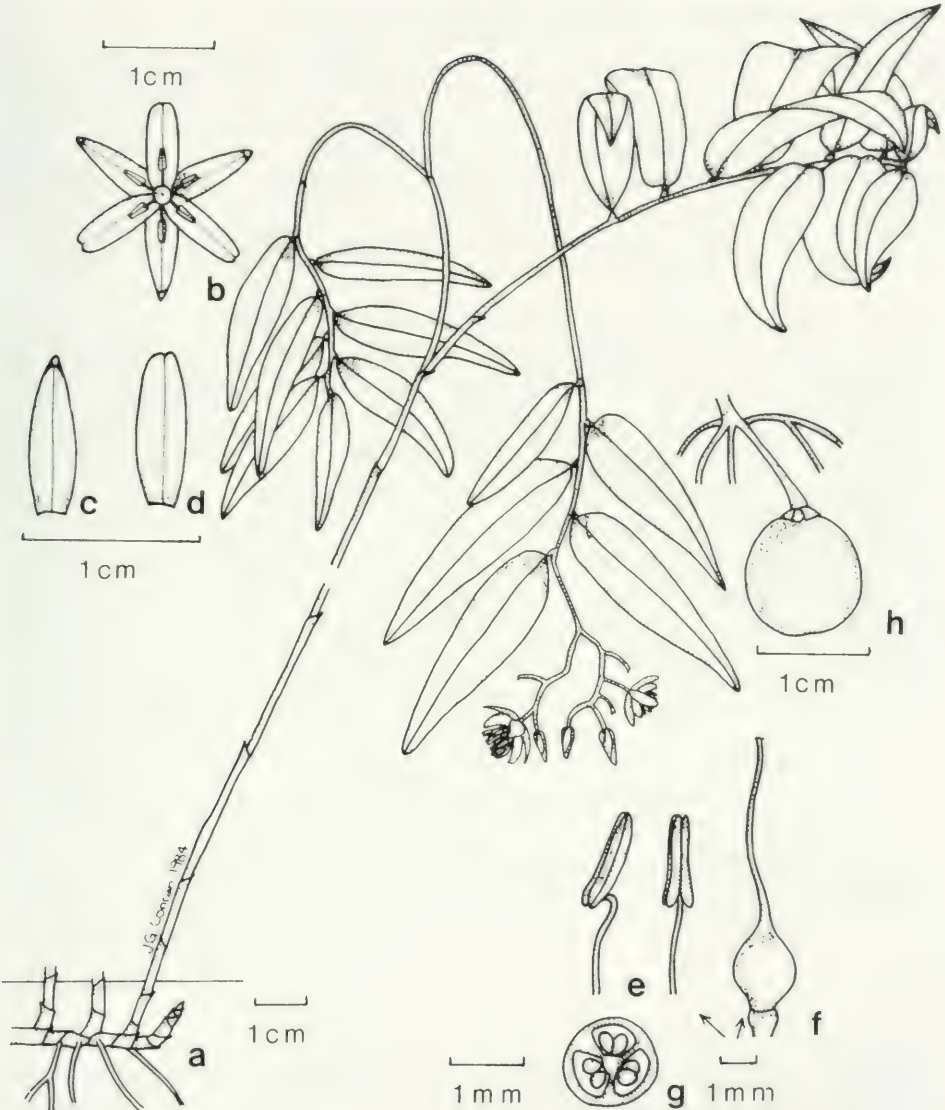


Fig. 2. *Geitonoplesium cymosum* (R.Br.) Hook. a. Flowering plant; b. flower; c. sepal; d. petal; e. stamen, side and front view; f. pistil; g. ovary, section; h. fruit (Conran 107). Drawing J.G. Conran.

***Geitonoplesium cymosum* (R.Br.) Hook.**

Geitonoplesium cymosum (R.Br.) A. Cunn. ex Hook., Bot. Mag. 59 (1832) t. 3131. — *Luzuriaga cymosa* R.Br., Prodr. Fl. Nov. Holl. (1810) 282; Standley & Ross, Fl. SE Queensl. 3 (1989) 67; A.C. Sm., Fl. Vit. Nova I (1979) 160; Conran & Clifford in Fl. Austral. 46 (1986) 194. — Type: *Brown 5665* (BM), New South Wales.

Eustrephus timorensis Ridley in Forbes, Nat. Wand. East. Arch. (1885) 520. — Type: *Forbes 3530* (K), Timor.

Luzuriaga laxiflora Hallier f., Nova Guinea 8 (1914) 991. — Type: *von Römer 932* (L), Irian Jaya.

Luzuriaga aspericaulis Hallier f., l.c. — Type: *Gjellerup 1078* (L), Irian Jaya.

Twining climber, 1–5 m tall. Roots fibrous. *Leaves* resupinate, with a short twisted petiole, broadly ovate to lanceolate or narrowly linear, 5–20 by 0.5–5 cm, rigid, the apex obtuse, acute or apiculate, with a prominent to obscure midrib. *Inflorescence* a small, loose terminal cyme or panicle of 1–many flowers; pedicel 0.5–3 cm long, with a small bract. *Perianth* segments 6–8 mm long, white, green or pink to purplish, sometimes streaked, oblong, distinctly nerved, equal in length, free almost to the base; pericladium short and subattenuate or absent. *Sepals* firm, shortly hood-shaped at apex. *Petals* flat, obtuse, slightly imbricate, the margins thin and entire. *Stamens*: filaments filiform, separate, geniculate below anther; pollen trichotomosulcate. *Fruit* a blue-black, globular, succulent, indehiscent berry, 8–15 mm in diam. *Seeds* 1–10, black, trigono-ovate. $2n = 20$ [Conran, Taxon 34 (1985) 346–347]. — **Fig. 2.**

Distribution — Eastern Australia and Fiji, north to New Ireland; *Malesia*: Lesser Sunda Islands (from Lombok eastwards), New Guinea.

Habitat & Ecology — Found on riverbanks, lakeshores, roadsides, thickets, grassy savannas, early secondary forest, and other relatively sunny areas, from sea level to 3000 m altitude.

Uses — Stems occasionally used as rope; in Australia young shoots sometimes eaten as a potherb.

HERNANDIACEAE

(Brigitta E.E. Duyfjes, Leiden)¹

Hernandiaceae Blume, Bijdr. (1826) 550, '*Hernandieae*'; Backer & Bakh. f., Fl. Java 1 (1963) 135–137; Kubitzki, Bot. Jahrb. 89 (1969) 78–209, 51 fig.; in Fl. Camb., Laos & Vietnam 12 (1970) 3–22, fig.; Ng in Tree Fl. Malaya 2 (1973) 244–247, fig.; Croft in Handb. Fl. Papua New Guinea 2 (1981) 190–201, fig.; A.C. Sm., Fl. Vit. Nov. 2 (1981) 108–113, 143–145, fig.; Du Puy & Telford in Fl. Austral. 50 (1993) 69–73, fig.; Kubitzki et al. (eds.), The families and genera of vascular plants 2, X (1993) 334. — Type genus: *Hernandia* L.

Trees, shrubs, or woody climbers, with bisexual or unisexual flowers. *Leaves* alternate or spirally arranged, petiolate, without stipules, simple, lobed or unlobed, or palmately compound, margin entire. *Inflorescences* usually axillary, much-branched, compound cymes, sometimes corymbose; with or without bracts. *Perianth* sepaloid with 3–8 imbricate or valvate segments (tepals) in 1 or 2 whorls. *Stamens* 3–7 in a single whorl opposite the tepals, or in a double whorl inserted opposite the outer tepals; filaments with two basal glands, or with one dorsal gland, or without glands; anthers 2-locular, dehiscing with 2 lateral or apical valves; interstaminal staminodes present or absent. *Ovary* inferior, 1-locular; ovule 1, pendulous; style simple, in male flowers absent or reduced; stigma discoid and oblique or capitate. *Fruits* dry, indehiscent, nut- or drupe-like, unwinged and enclosed by inflated, fleshy, expanded cupule (*Hernandia*) or not, or with 2–4 lateral wings (*Illigera*) or with 2 apical wings (*Gyrocarpus*). Seed 1, without endosperm; embryo straight; cotyledons large.

DISTRIBUTION

A family of 4 genera, *Gyrocarpus* (3 species) and *Hernandia* (24 species) both tricentric-tropical, *Illigera* (c. 20 species) in the African–Asian–Malesian region, and *Sparattanthelium* (13 species) in Central America and Mexico.

HABITAT AND ECOLOGY

Habitat — Mostly confined to the everwet tropics, but several species are characteristic of areas with a marked periodical drought (*Gyrocarpus*, some species of *Illigera*). The majority of the species occurs in the tropical lowland areas, only some SE Asian *Illigera* species and some local-endemic Pacific *Hernandia* species reach the submontane zone.

Pollination — No observations are recorded, but the flowers of *Hernandia* and *Illigera* are often reported to be fragrant and the staminal appendages of *Illigera* seem to function as nectaries; the pollen grains of both genera are large and sticky. These characters suggest that the *Hernandia* and *Illigera* species may be entomogamous. The flowers of *Gyrocarpus* and *Sparattanthelium* are small and numerous, especially the male ones.

1) With contributions by P. Baas, Leiden (vegetative anatomy), R.W.J.M. van der Ham, Leiden (paleontology), and R. Hegnauer, Leiden (phytochemistry).

They are not fragrant and pollen grains are small and powdery; these genera are possibly anemogamous.

Dispersal — All *Hernandiaceae* have more or less drupaceous fruits which are winged in *Illigera* and *Gyrocarpus*. The fruits may be drifted by the wind over short distances. Fruits of *G. americanus* and *H. nymphaeifolia* have been observed drifting in the sea, and can retain their buoyancy for several months; in both species the buoyancy is apparently effected by the spongy testa.

TAXONOMY

The genera here recognized in *Hernandiaceae* have a checkered taxonomic history. Kubitzki (1969) comprehensively dealt with it. Most authors agree upon a relation with *Lauraceae*. *Gyrocarpus* is often placed in a separate family, *Gyrocarpaceae*. Pax (1889) established *Hernandiaceae* in the present sense, with four genera, divided into two sub-families, *Hernandioideae* (*Hernandia* and *Illigera*) and *Gyrocarpoideae* (*Gyrocarpus* and *Sparattanthelium*); this was followed by Kubitzki (1969). See also page 761.

References: Kubitzki, K., Bot. Jahrb. 89 (1969) 78–209. — Pax, F.A., in Engler & Prantl, Nat. Pflanzenfam. 3, 2 (1889) 129.

VEGETATIVE ANATOMY

(P. Baas)

Leaf anatomy — Metcalfe (1987) gave a detailed leaf anatomical account of all genera, incorporating information from the literature. Below follows a summary for the three genera occurring in Malesia. Nonglandular, simple hairs range from straight to curved or hooked. Glandular hairs are absent from *Gyrocarpus*; in *Hernandia* and *Illigera* they are globular or pear-shaped with a unicellular stalk and a unicellular or multicellular body. Stomata paracytic in *Illigera* and *Hernandia*; the anomocytic stomata in *Gyrocarpus* have parallel cuticular flanges, recalling paracytic stomata. Cystoliths present in *Gyrocarpus*, absent in *Hernandia* and *Illigera*.

Wood anatomy — For full bibliographies on the wood anatomy of *Hernandiaceae*, see Gregory (1994) and Metcalfe (1987). Growth rings absent to distinct. Vessels diffuse, solitary and in radial multiples, with simple perforations. Intervessel pits alternate, vessel-ray pits coarse and with reduced borders. Fibres thin-walled in most species, with minutely bordered to simple pits (*Gyrocarpus*, *Hernandia*) or distinctly bordered ones (*Illigera*). Parenchyma paratracheal, vasicentric to aliform (*Gyrocarpus* and *Hernandia*) or scanty (*Illigera*). Rays mostly multiseriate, homocellular to heterocellular. Secretory (oil or mucilage) cells present in varying frequency among the axial parenchyma in *Gyrocarpus* and *Hernandia*, among ray parenchyma in *Illigera*. Crystalliferous cells noted in rays of some species of *Hernandia*.

Taxonomic aspects — On balance the anatomical evidence is inconclusive with respect to the status of *Gyrocarpus* and the New World genus *Sparattanthelium* as a separate

family, *Gyrocarpaceae*. In their leaf anatomy the latter share the presence of cystoliths (also present in the wood of *Sparattanthelium*) but in wood anatomy they do not differ substantially from *Hernandia*; *Illigera* appears more isolated.

References: Gregory, M., Bibliography of systematic wood anatomy of Dicotyledons, IAWA J. Suppl. 1 (1994). — Metcalfe, C.R., Anatomy of the Dicotyledons, ed. 2, 3 (1987) 174–184.

PALYNOLOGY

(R.W.J.M. van der Ham)

Pollen of the *Hernandiaceae* has been more or less extensively described and illustrated with light micrographs or drawings by Agababian (1969), Kubitzki (1969) and Mitroiu (1970). Scanning electron micrographs of *Illigera* pollen were included by Walker (1976a, b), Straka & Friedrich (1988) and Tang & Shang (1995).

The pollen grains of the *Hernandiaceae* are small to very large (19–168 µm), spheroidal and inaperturate (functionally omniaperturate). The exine is very thin, intectate, and loosely to densely covered with warts (*Sparattanthelium*) or 1.8 to 9.6 µm long spines. A transmission electron micrograph of the wall of *Hernandia* pollen (Hesse & Kubitzki 1983) shows a c. 0.4 µm thick granular exine with a solid conical spine. In *Illigera* pollen the spines have flattened contiguous bases. The intine is always distinctly thicker than the exine. In *Hernandia* and *Illigera* it consists of a thin homogeneous inner layer and a thick outer channeled layer. In the other two genera the intine seems to be homogeneous throughout (Kubitzki 1969).

Two pollen types may be distinguished: *Hernandia* and *Illigera* have large (83–168 µm) pollen grains, provided with pollenkitt and a stratified intine, while *Gyrocarpus* and *Sparattanthelium* have smaller (19–64 µm) grains, without pollenkitt, and, as far as known, a homogeneous intine. These differences are probably associated with contrasting pollination types: entomogamy and anemogamy respectively.

The pollen grains of *Hernandia* and *Illigera* are very similar. However, no special characters indicating the monophyly of the family in its present circumscription have been found. Pollen of the *Hernandiaceae* is like that of several *Lauraceae*, and the pollen of *Hernandia* and *Illigera* also resembles that of *Peumus* of the *Monimiaceae* (Erdtman 1952; Shutts 1960; Walker 1976a, b; Hesse & Kubitzki 1983; Tang & Shang 1995). A cladistic analysis of 49 taxa of *Magnoliidae* by Loconte & Stevenson (1991) using 104 characters confirmed the monophyly of the *Hernandiaceae* and the above subdivision of the family, and indicated a sister group relation to the *Lauraceae*. However, pollen morphology did not contribute to these results, because the ten pollen characters used were coded similarly in the *Lauraceae* and the four genera of the *Hernandiaceae*.

References: Agababian, V.S., Biol. Zh. Armenii 22, 3 (1969) 45–58. — Erdtman, G., Pollen morphology and plant taxonomy (1952). — Hesse, M. & K. Kubitzki, Pl. Syst. Evol. 141 (1983) 299–311. — Kubitzki, K., Bot. Jahrb. 89 (1969) 78–148. — Loconte, H. & D.W. Stevenson, Cladistics 7 (1991) 267–296. — Mitroiu, N., Acta Bot. Hort. Bucurest. 1969 (1970) 3–243. — Shutts, C.F., Trop. Woods 113 (1960) 85–123. — Straka, H. & B. Friedrich, Trop. Subtrop. Pflanzenwelt 61 (1988) 5–117. — Tang, G.G. & C.B. Shang, Acta Phytotax. Sinica 33 (1995) 161–170. — Walker, J.W., Linn. Soc. Symp. Ser. 1 (1976a) 251–308; in C.B. Beck, Origin and early evolution of Angiosperms (1976b) 241–299.

PHYTOCHEMISTRY

(R. Hegnauer)

Several reviews of the chemistry of the family are available (Hegnauer 1966, 1989; Kubitzki 1969; Pernet 1971; Gottlieb et al. 1993). It has to be stressed, however, that thorough chemical investigations are restricted to a few species of *Illigera* and *Hernandia* and to alkaloids of *Gyrocarpus americanus* and *Sparattanthelium uncigerum*. A summary of presently known chemical data follows.

Kubitzki (1969) investigated phenolics in hydrolized leaf extracts and reported genus-characteristic patterns. Kaempferol, quercetin and its 3'-methylether isorhamnetin were detected in 14 taxa of *Hernandia* and occurred erratically and usually in trace amounts only in *Illigera* (16 taxa investigated), *Gyrocarpus americanus* and *jatrophiifolius* and *Sparattanthelium* (12 taxa). Vitexin-like C-glycoflavones were present in *Hernandia albiflora* and in all taxa of *Illigera* and in trace amounts in 7 taxa of *Sparattanthelium*. Proanthocyanidins were present in large to moderate amounts in 7 taxa of *Hernandia*, 14 taxa of *Illigera*, but were totally lacking in *Gyrocarpus* and *Sparattanthelium*. Ferulic and sinapic acids were detected in trace to moderate amounts in practically all taxa of *Hernandia*, *Gyrocarpus* and *Sparattanthelium* and were lacking in *Illigera*. The apparent absence of the wide-spread *p*-coumaric and caffeic acids and the greatly reduced or totally suppressed production of flavonols and flavones in *Gyrocarpus* and *Sparattanthelium* represent notable features of phenolic metabolism of *Hernandiaceae*. Concerning flavonoids it should not be forgotten, however, that screening procedures of the type applied by Kubitzki and making use of herbarium material are useless for the detection of flavanones and flavanonols (= 2,3-dihydroflavonols). Indeed, prenylated and/or geranylated flavanones, the nymphaeols -A to -C, were isolated from *H. nymphaeifolia* (Presl) Kubitzki (= *H. peltata*; Japanese name 'Hasunoha-giri') (Yakushijin et al. 1980).

One class of compounds is relatively well known from the family. Alkaloids have been detected in all four to five genera. They belong to the phenylalanine-tyrosine-derived family of isoquinoline alkaloids and are represented by the benzyloisoquinoline-, aporphine-, oxo-aporphine-, N,N-dimethylaminoethyl-phenanthrene-types and by dimeric derivatives of these monomers. A strange compound is 3-cyano-4-methoxypyridine from *H. nymphaeifolia* (Yakushijin et al. 1980); as yet its biogenesis is not known.

Lignans seem to occur frequently in stems, leaves and seeds of many species of *Hernandia*. Hitherto they were not yet isolated from representatives of other hernandiaceous genera. Known *Hernandia* lignans belong to several types: furofuranoid-, tetralin (= tetrahydronaphthalene)-, naphthalene- and bibenzylbutanolide-types; examples (isolated from *Hernandia* taxa) are epimagnolin, podophyllotoxin, 1,2,3,4-tetrahydrodehydroxypodophyllotoxin and podorhizol. Two new lignans, dimethylmatairesinol and 5'-methoxypodorhizol, were isolated from seeds of *H. ovigera*; seeds of this taxon yielded eleven lignans till today (Tanoguchi et al. 1991). Neolignans were not yet detected in the family.

Oil cells of the magnolioid type are wide-spread in the family: they occur mainly in leaves and in the primary cortex and pith of stems (Kubitzki 1969) and perhaps also in roots and fruits. Their presence indicates that essential oils should be of common occurrence. However, only a few investigations of essential oils are reported in literature. *Hernandia peltata* yielded essential oils from roots, stems and fruits in Madagascar: the wood oil (2%) had perillaldehyde as main compound and myrtenal, cineol and limonene as additional monoterpenes. The smell of perillaldehyde is described in literature as cuminalike or as camphoraceous (Gildemeister & Hoffmann 1959, 1963; Guenther 1949; Weber 1974). Perillaldehyde is also the principal constituent of the essential oil of bark and twigs of Madagascan *H. voyroni* [= *Hazomalania voyroni* (Jumelle) Capuron] (Weber 1974).

Metcalfé (1987) stated "oil cells have been reported in all genera and species and they are sometimes accompanied by mucilage cells." The last-mentioned feature reminds of *Lauraceae* and explains observations made by Greshoff that the bark of *H. ovigera* and *H. sonora* is mucilaginous.

Hernandiaceae have seeds without endosperm (all ?) containing embryos with large cotyledons. Some hints can be found in literature that several species store large amounts of fatty oils in their seeds, but exact information is scarce. According to Netolitzki (1926) *Hernandiaceae* (which?) store fatty oils, protein bodies and starch in cotyledons. Corner (1976) stressed the fact that hitherto only seeds of *Hernandia* were studied in some detail and drew attention to similarities between seeds of *Hernandia* and those of *Myristicaceae*.

Usually affinities of *Hernandiaceae* with *Lauraceae* and *Monimiaceae* are assumed. As far as chemical data are available they do not contradict such a relationship.

References: Corner, E.J.H., The seeds of dicotyledons, vol. 1 (1976) 152. — Gildemeister, E. & F. Hoffmann, Die ätherischen Öle, ed. 4 (ed. W. Treibs), 3 (1963) 115 (Perillaaldehyd); 5 (1959) 149–151 (*Hernandiaceae*). — Gottlieb, O.R., et al., pp. 20–31, 337 in K. Kubitzki et al. (eds.), The families and genera of flowering plants, vol. 2 (1993). — Guenther, E., The essential oils 2 (1949) 342 (perillaldehyde). — Hegnauer, R., Chemotaxonomie der Pflanzen 4 (1966) 246–249, 502; 8 (1989) 557–562. — Kubitzki, K., Monographie der Hernandiaceen. Bot. Jahrb. 89 (1969) 78–209 (Chemische Merkmale 97–105). — Kubitzki, K., *Hernandiaceae*, pp. 334–338 in K. Kubitzki et al. (eds.), The families and genera of flowering plants, vol. 2 (1993). — Metcalfé, C.R., Anatomy of the Dicotyledons, ed. 2, 3 (1987) 174–184 (*Hernandiaceae*). — Netolitzki, F., Anatomie der Angiospermen-Samen, in Linsbauers Handbuch der Pflanzenanatomie 10 (1926). — Pernet, R., Revue des Hernandiacees, Planta Medica 20 (1971) 314–319. — Tanoguchi, M., et al., Chem. Pharm. Bull. 39 (1991) 1873. — Weber, N., Phytochemistry 13 (1974) 2006. — Yakushijin et al., Heterocycles 14 (1980) 161; Phytochemistry 19 (1980) 161.

USES

Some *Hernandia* species and *Gyrocarpus americanus* produce a rather soft and not very valuable wood, used for making canoes and as timberwood. The oil of the seeds of *Hernandia nymphaeifolia* is used locally as lampoil, but is of inferior quality (Heyne 1950).

Reference: Heyne, K., Nutt. Pl. Indon., ed. 3 (1950) 674.

KEY TO THE GENERA

- 1a. Woody climbers. Leaves palmately compound, petioles twisting. Fruits with 2–4 lateral wings (wings sometimes ridge-like) **Illigera** (p. 751)
- b. Trees. Leaves simple, petioles not twisting. Fruits with 2 apical wings or fruits surrounded by an inflated cupule. 2
- 2a. Deciduous trees. Inflorescences without bracts, flowers minute, buds less than 1.5 mm diameter. Fruits with 2 apical wings **Gyrocarpus** (p. 742)
- b. Evergreen trees. Inflorescences with bracts, flowers conspicuous, buds more than 2 mm diameter. Fruits surrounded by an inflated cupule **Hernandia** (p. 744)

GYROCARPUS

Gyrocarpus Jacq., Select. Stirp. Amer. (1763) 282; Kubitzki, Bot. Jahrb. 89 (1969) 181; Kubitzki et al. (eds.), The families and genera of vascular plants 2, X (1993) 337. — Type species: *Gyrocarpus americanus* Jacq.

Deciduous trees. *Leaves* simple, entire or 3(–5)-lobed; veining palmate. *Inflorescence* axillary or terminal, a more or less repeatedly dichotomous corymbose thyrs, ebracteate, sometimes precocious. *Flowers* bisexual or unisexual (mostly male), numerous, small (less than 1.5 mm). *Bisexual* and *female flowers* with (6–)7(–8) perianth segments (tepals), four of these forming an opposite pair, each pair consisting of two adjacent tepals with common basal meristem growing out during and after anthesis into two spatulate wings on top of the nut; style sigmoid, stigma capitate; *stamens* 4 or 5, or less, filaments provided with small dorsal glands or not; clavate staminodes alternating with stamens. *Male flowers* similar to bisexual flowers, with 4–7 perianth segments (tepals); ovary and style reduced or absent; wings absent; *stamens* 4–7, more conspicuous than in bisexual flowers; staminodes 4 or 5, free and alternating with stamens or (not in Malesia) fused. *Fruit* a samara; nut ovoid or elongate-ellipsoid with two large apical spatulate wings; pericarp hard, rather thick. *Seeds* with spongy testa (in one American species membranous); cotyledons contortuplicate.

Distribution — A pantropical genus of 3 species: *G. jatrophifolius* Chiov. in Central America; *G. hababensis* Domin in E Africa; *G. americanus* widely distributed throughout the tropics.

Habitat — Open, often rocky places, in light or deciduous forests, sometimes in rain forests; also at the shore.

Dispersal — The falling fruit quickly rotates, the wings being stretched out in an angle of 120–140°, facilitating a steady fall created by the air-resistance, and achieving dispersal over short distances (Von Wahl 1897, Biblioth. Bot. 40: 14). The fruits of *G. americanus* and *G. hababensis* can be carried by water, the buoyancy due to the spongy seed-coat. Testified by the wide coastal distribution of these species, this kind of dispersal apparently is effective.



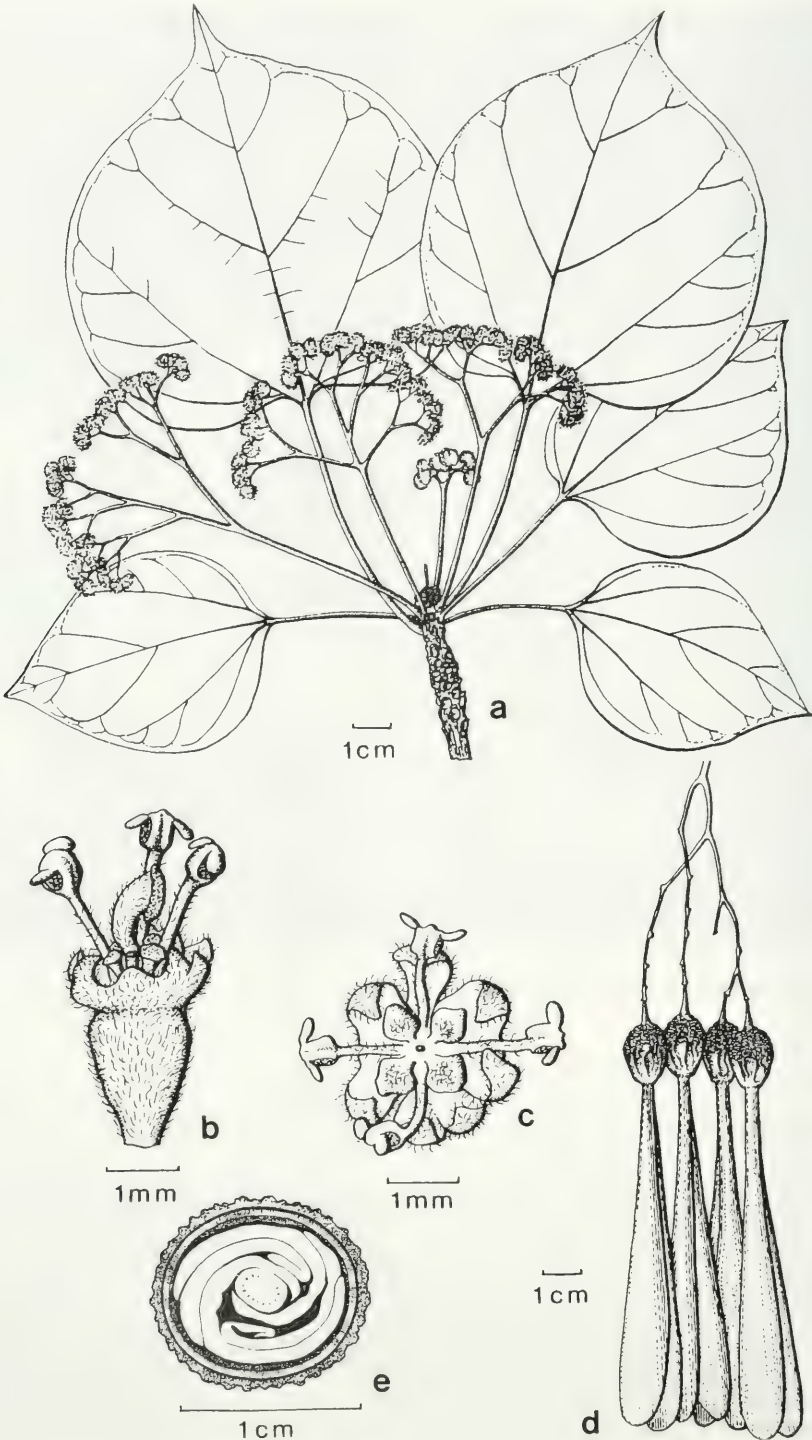
Fig. 1. *Gyrocarpus americanus* Jacq. Leafy twig and infructescence. Sri Lanka. Photo T.B. Worthington, 1965.

***Gyrocarpus americanus* Jacq.**

Gyrocarpus americanus Jacq., Select. Stirp. Amer. (1763) 282, t. 178, f. 80; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 205; Backer & Bakh.f., Fl. Java 1 (1964) 136; Kubitzki, Bot. Jahrb. 89 (1969) 182; Ng in Tree Fl. Malaya, 2 (1973) 244, f. 1. — *Gyrocarpus americanus* subsp. *americanus*: Kubitzki, Bot. Jahrb. 89 (1969) 183, f. 45; Croft in Handb. Fl. Papua New Guinea 2 (1981) 191, f. 42; A.C. Sm., Fl. Vit. Nov. 2 (1981) 143, f. 46; Du Puy & Telford in Fl. Austral. 50 (1993) 72. — Type: *Jacquin s.n.* (BM), Colombia, Cartagena.

Gyrocarpus jacquini Gaertn., Fruct. 2 (1791) 92, t. 97, nom. illeg.; Ridley, Fl. Malay Penins. 3 (1924) 139. — Type: 'E collectione Sem. Banksiana'.

Gyrocarpus lobatus Blanco, Fl. Filip. 2 (1845) 54; Merr., Sp. Blanc. (1918) 155. — Type: destroyed; neotype, illustrative specimen: *Merrill Sp. Blanc.* 755, Philippines.



Gyrocarpus asiaticus Willd. var. ?*javanicus* Meisn. in A.DC., Prodr. 15 (1864) 248. — *Gyrocarpus jacquini* Gaertn. var. *javanicus* Domin, Bibl. Bot. 89 (1925) 680. — Type: Zollinger 2889 (A, BM, BR, FI, NY), Java.

Gyrocarpus rugosus R. Br. var. ?*philippinensis* Meisn. in A.DC., Prodr. 15 (1864) 248. — Type: Llanos s.n., 1853 (NY, fragm. ex G-DC), Philippines.

Tree 3–30 m high, dbh 20–100 cm, trunk smooth or with coarse scales, pale grey or nearly white. *Leaves*: petiole 4–19.5 cm long; leaf-blade coriaceous or chartaceous, entire, or in young trees with 3 or 5 acute lobes, cordate to ovate, 7–24 by 4–21 cm, base cordate to broadly rounded to cuneate, apex c. 1 cm acuminate, pubescent on both surfaces or the upper surface glabrous, nerves conspicuous, 3- or 5-palminerved, with ladder-like tertiary veining. *Inflorescence* (including 3–6 cm long peduncle) 5–17 cm long, the flowers compact, all parts more or less pubescent. *Flowers* 4-merous, small (mature bud less than 1.5 mm diam.), bisexual and unisexual (only male flowers), pale green or creamy; filaments in female flowers c. 1.5 mm long, in male flowers c. 2 mm long with 4 alternating small glands, 0.5–1 mm long. *Fruits*: nut ovoid, 1.4–2 by 0.8–1.3 cm, longitudinally 8-ribbed, topped with a pair of spatulate wings, 6.5–9 cm long, 2–3 mm wide at base, 0.8–1.1 cm wide at widest part, resembling those of certain dipterocarps, yellowish green; the whole fruit thinly up to thickly pubescent, seldom glabrous. — **Fig. 1, 2.**

Distribution — Pantropical, in regions with a monsoon climate; in *Malesia*: Peninsular Malaysia, E Java, Philippines, Lesser Sunda Islands, Papua New Guinea (around Port Moresby and in Ramu Valley).

Habitat & Ecology — Frequently found near the shore: on beach, on rocky slopes, in dune scrub; also in savanna, sclerophyll forest on calcareous soil, poor monsoon forest on low hills, stony crests, limestone hills, and banks of gulleys; 0–200 m altitude.

Fieldnotes — Branches ascending with drooping branchlets. Slashed wood with creamy or yellowish exudate; bruised tissue with unpleasant smell. Frequently mentioned as flowering or fruiting while the tree is leafless. The leaves are convex at the time they are falling off. According to *Merrill Sp. Blanc.* 755, the species is in the Philippines widely distributed, but nowhere abundant.

Notes — Kubitzki (1969) distinguished 7 subspecies in *G. americanus* on characters of outline and hair-covering of the leaves, with in the Malesian area 2 subspecies: subsp. *americanus*, occurring in the whole area, and subsp. *sphenopteris* (R.Br.) Kubitzki in the Lesser Sunda Islands (Sumbawa) and the Philippines (Luzon). More field observations are needed to clarify the position of these taxa.

Fig. 2. *Gyrocarpus americanus* Jacq. a. Flowering twig; b. bisexual flower; c. male flower, seen from above; d. fruits; e. fruit, transverse section showing contortuplicate cotyledons (a: Cuatrecasas 25451; d: Calderón 1674; b, c, e from living material). Reproduced with permission of Bot. Jahrb. 89 (1969).

HERNANDIA

Hernandia L., Sp. Pl. (1753) 981; Kubitzki, Bot. Jahrb. 89 (1969) 122; in Fl. Camb., Laos & Vietnam 12 (1970) 17; Kubitzki et al. (eds.), The families and genera of vascular plants 2, X (1993) 337. — Type species: *Hernandia sonora* L.

Biasolettia Presl, Rel. Haenk. 2 (1835) 141. — Type species: *Biasolettia nymphaeaeifolia* Presl.

Trees or shrubs. *Leaves* simple, undivided (seldom 3–5-lobed), peltate (*H. nymphaeaeifolia* in Malesia) or not, venation palmate or with 3–7 pairs of lateral veins, arching towards the apex. *Inflorescence* usually at and towards the tips of branchlets, the peduncles distinct (rarely short), the ultimate partial inflorescences comprising of modified cincinni and these usually subtended by an involucre of 4 bracts comprising 3 flowers: 2 lateral (rarely 1) pedicelled male flowers, and 1 central subsessile female flower (rarely 1 bisexual flower). All parts of inflorescence finely pubescent, rarely glabrous. *Bracteoles* of male flowers more or less equal, those of female flowers united into a cupule partly or wholly surrounding the ovary, accrescent at maturity, or female bracteoles seldom free (*H. bivalvis* Benth., Australia; *H. voyroni* Jum., Madagascar). Outer tepals quincuncial or imbricate, the inner ones partly valvate. *Male flowers* 3–5(–6)-merous; ovary and style lacking or style rudimentary; *stamens* 3–5(–6), filaments free or partly connate, each with two basal glands free or glands connate. *Female flowers* 4–6-merous; *ovary* somewhat compressed laterally, without staminodes; style sigmoid or straight, at base often thickened and surrounded by 4–5(–10–12) free or connate glands; stigma dilated or irregularly lobed. *Drupe* ovoid to ellipsoid, often inconspicuously longitudinally ribbed, with or without an umbo (wart) at apex, at maturity enclosed by the inflated, fleshy cupule, or not (*H. bivalvis*, *H. voyroni*, not in Malesia). *Seeds* with a hard, sometimes spongy testa; cotyledons free or (in Malesia) fused, ruminant.

Distribution — Pantropical genus of 24 species (Kubitzki 1969); in *Malesia* 3 species.

Habitat & Ecology — Mostly in primary and secondary lowland rain forest, coastal forest. In the Pacific some species reach the submontane zone, up to 1500 m altitude.

KEY TO THE SPECIES

- 1a. Leaves peltate 2. *H. nymphaeaeifolia*
- b. Leaves not peltate 2
- 2a. Leaf-base cordate or broadly rounded, domatia absent. Mature cupule of fruit 3–8 cm long, margin of orifice 2- (or -3-)toothed 3. *H. ovigera*
- b. Leaf-base acute or rounded, domatia present. Mature cupule of fruit 2.5–3 cm long, margin of orifice entire 1. *H. moerenhoutiana*

1. *Hernandia moerenhoutiana* Guill.

Hernandia moerenhoutiana Guill., Ann. Sc. Nat. Bot. II, 7 (1837) 189; Kubitzki, Bot. Jahrb. 89 (1969) 127, f. 23–25 (3 subsp.). — Type: *Bertero & Moerenhout s.n.* (G, P), Tahiti.

Hernandia moerenhoutiana Guill. subsp. *samoensis* auct. non (Hochr.) Kubitzki: Croft in Handb. Fl. Papua New Guinea 2 (1981) 194 (see the note).

Tree, 12–30 m high, c. 30 cm dbh. *Leaves*: petiole 3–6 cm; blade coriaceous, elliptic to oblong, 6–13.5 by 3.5–6 cm, apex broadly rounded (seldom truncate) or obtuse, or acute, base acute or rounded, margin revolute, glabrous on both surfaces but lower surface of young leaves hairy, basal nerves 3, palmate, and midrib with 2 pairs of arching lateral ones, whitish or yellow; domatia present. *Inflorescence* including the 6–13 cm long peduncle 10–20 cm long; involucre bracts elliptic to obovate, 10–11 by 5–8 mm; flower buds globose-ovoid, 3–5 mm in diam. *Flowers* 4- or 5-merous, white, sweetly fragrant. *Male flowers*: pedicel c. 4 mm long, tepals c. 6 mm long, *stamens* 5, filaments c. 1.5 mm long, laxly pilose, each at base with two stippled glands, c. 1 mm long, stipe 0.5 mm long. *Female flowers*: pedicel c. 1 mm long, flower (including ovary) 7.5–8.5 mm long, ovary entirely enveloped by the cupule, tepals c. 5.5 mm long, style c. 2 mm long, surrounding glands 5 (sometimes more glands, but then smaller), firm, c. 1 mm long; cupule in anthesis 2–3 by 4 mm, faintly ribbed, in fruit inflated, loosely enclosing the drupe, green turning red, 2.7–3 cm long, the orifice 1.5–2.5 cm diam., margin irregularly undulate. *Drupe* shorter than the cupule, ovoid, laterally compressed, c. 2 by 1.5 cm, faintly 10-ribbed, the apex with a half-rounded umbo, which is contracted at the beak.

Distribution — Widespread in the Pacific from Manus I. eastward to the Society Islands; in *Malesia*: Papua New Guinea (Manus I., New Britain).

Habitat & Ecology — Found in lowland rain forest on ridges, in colline rain forest on limestone boulders; 100–830 m altitude.

Note — *Hernandia moerenhoutiana* is common and widespread in the Pacific. Kubitzki (1969) accepted in this species three subspecies, viz. subsp. *moerenhoutiana* (Tahiti, Cook Is.), subsp. *campanulata* (Tonga Is., Fiji, Samoa) and subsp. *samoensis* (Solomon Is., Santa Cruz, Samoa). A much related species, *H. cordigera* Vieillard, is restricted to New Caledonia. Kubitzki distinguished these two species on the dimensions of the cupule at anthesis: broader than long leads to *H. cordigera* and longer than broad to *H. moerenhoutiana*. Croft (1981) put the Malesian material into subsp. *samoensis*, but I doubt whether this is correct: the cupules are broader than long and the leaf apices also do not match. The Malesian material very much resembles *H. cordigera*, and pending the availability of more material I prefer to leave it in *H. moerenhoutiana* s.l.; possibly the Malesian and part of the Solomon material represents a fourth subspecies, as yet undescribed.

2. *Hernandia nymphaeifolia* (Presl) Kubitzki

Hernandia nymphaeifolia (Presl) Kubitzki, Bot. Jahrb. 90 (1970) 272; Ng in Tree Fl. Malaya 2 (1973) 245, f. 2; Croft in Handb. Fl. Papua New Guinea 2 (1981) 193, f. 43; A.C. Sm., Fl. Vit. Nov. 2 (1981) 110, f. 39; Corner, Wayside Trees 1, 3 (1988) 363, f. 120; Du Puy & Telford in Fl. Austral. 50 (1993) 71. — *Biasoletia nymphaeaeifolia* Presl, Rel. Haenk. 2 (1835) 142. — Type: *Haenke s.n.* (PR), Guam.

Hernandia peltata Meisn. in A.DC., Prodr. 15 (1864) 263; Koord. & Valetton, Atlas 1 (1913) f. 184; Backer & Bakh. f., Fl. Java 1 (1964) 137, excl. syn. *H. javanica* Tuyama; Kubitzki, Bot. Jahrb. 89 (1969) 153. — Type: *Thwaites CP 2914* (G-DC lecto; B, BM, G, L, W), Sri Lanka.

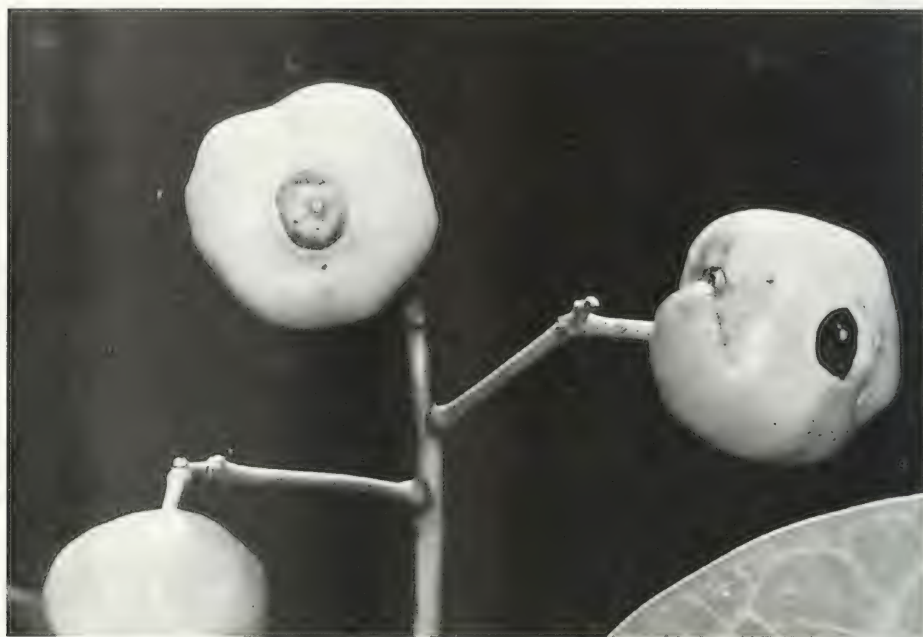


Fig. 3. *Hernandia nymphaeifolia* (Presl) Kubitzki. Part of infructescence showing three fruits enclosed by the inflated cupules. Tree along the southcoast of Java. Photo W. J. J. O. de Wilde, 1995.

Shrub or tree 5–22 m high, dbh up to 90 cm (in Fiji up to 200 cm, A. C. Smith 1981). *Leaves*: petiole 5–17 cm long, peltately attached 0.5–3 cm from the margin; blade chartaceous or thinly coriaceous, shining above, dull beneath, narrowly or broadly ovate, or subcircular, 7–33 by 6–29 cm, apex acute or slightly acuminate, glabrous on both surfaces, nerves 5–9, palmate, conspicuously white or yellow, the central nerve with 2–4 lateral nerves per side, arching towards apex, domatia absent. *Inflorescence* including the 6–20 cm long peduncle 10–30 cm long; involucre bracts elliptic to obovate, 2–6 by 1–3.5 mm. *Flowers* 3-merous (male) or 4-merous (female), greenish or white, fragrant. *Male flowers*: pedicel 4–4.5 mm long, tepals c. 5 mm long; anthers yellow, filaments c. 3 mm long, each basally with two subspathulate glands c. 1 mm long, free or pairwise fused between the stamens. *Female flowers*: pedicel absent; flower (including the ovary) 8–10 mm long, ovary up to halfway enveloped by the cupule; tepals c. 5 mm long, style papillose, c. 3 mm long, surrounding glands 4 (sometimes more), firm, c. 1 mm long, free or fused, stigma pink; cupule in anthesis c. 2 by 3 mm, the margin entire or slightly undulate, in fruit loosely enclosing the drupe, inflated, bell-shaped, fleshy and waxy white or reddish, the margin of the orifice entire and slightly revolute. *Drupe* as long as the cupule or somewhat exserted, ellipsoid, 2.5–3 by 1.5–2.3 cm, faintly longitudinally 8-ribbed, slightly stalked or not, apex with an umbo, 8–10 mm wide, 2–3 mm high. — **Fig. 3.**

Distribution — E Africa, Madagascar, Sri Lanka, Andaman & Nicobar Islands, Thailand, Cambodia, Vietnam, Taiwan, Micronesia (northward to Ryukyu & Bonin Islands), Melanesia, Polynesia; in *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Java, Christmas Island (Indian Ocean), Lesser Sunda Islands, Philippines, Celebes, Moluccas, New Guinea.

Habitat & Ecology — Occurs exclusively in coastal areas: along the sea-shore (recorded as leaning over the sea and even sometimes immersed by sea water), in primary and secondary littoral forest (*Barringtonia asiatica* association), also behind the beach in swampy places; on sand, coral beach, or pebbles; at low altitude.

Notes — 1. The wood is soft and light in weight and of little use as timber; in some parts of the Pacific it is used for making canoes.

2. According to Kubitzki (1969) the species seems to hybridize with *H. ovigera*.

3. *Hernandia ovigera* L.

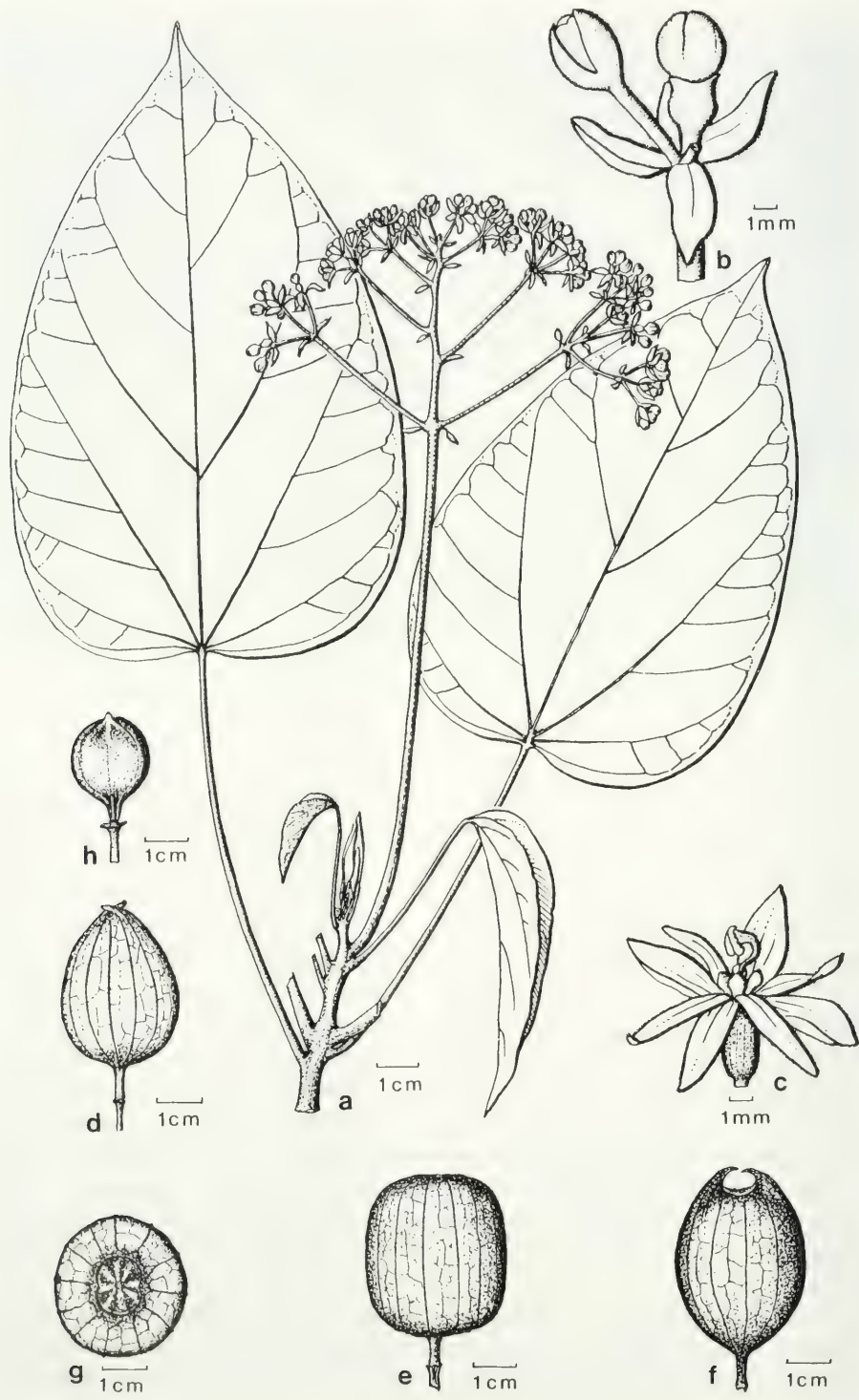
Hernandia ovigera L. (Diss. O. Stickman), Herb. Amboin. (1754) 14; Rumph., Herb. Amboin. 3 (1743) 193, t. 123; Koord. & Valetton, Atlas 1 (1913) f. 185; Backer & Bakh.f., Fl. Java 1 (1964) 137; Kubitzki, Bot. Jahrb. 89 (1969) 138, f. 31; Croft in Handb. Fl. Papua New Guinea 2 (1981) 196, f. 44; Du Puy & Telford in Fl. Austral. 50 (1993) 70, f. 32 F-H. — Type: Rumphius (1743: t. 123).

Hernandia papuana C.T. White, J. Arnold Arbor. 10 (1929) 216. — Type: *Brass* 1073 (A), Papua New Guinea, Madang.

Hernandia javanica Tuyama, Bull. Sigenkagaku Kenkyusyo 1 (1943) 44. — Type: not indicated.

Tree, 20–40 m high, dbh 50–100 cm. *Leaves*: petiole 7–19 cm; blade chartaceous or coriaceous, broadly lanceolate to broadly ovate, 10–25(–40) by 6–21(–30) cm, apex 0.5–1(–2) cm acuminate, base more or less cordate or broadly rounded, shining and glabrous on both surfaces but nerves on lower surface pubescent, nerves 5 (or 7), palmate, the midrib with 3–6 pairs of lateral nerves; domatia absent. *Inflorescence* including the 6–18 cm long peduncle 15–30 cm long; involucre bracts elliptic or obovate, 4–7 by 1–3 mm. Flower buds ellipsoid. *Flowers* 3-merous (male), or 4-merous (female), creamy-white, fragrant. *Male flowers*: pedicel 4–5 mm long, tepals c. 7 mm long, *stamens* 3, filaments sparsely pilose or glabrous, each filament with 2 glands c. 1 mm long. *Female flowers*: pedicel c. 1.5 mm long, flower including the ovary c. 1 cm long, ovary entirely enveloped by the cupule, tepals 4–5 mm long, style c. 5 mm long, at the base surrounded by 4 unstiped glands, free, c. 1 mm long; cupule in anthesis fleshy, green, 3–5 by c. 2.5 mm, the margin 2-lobed, in fruit inflated, loosely enclosing the drupe, egg-shaped, 3–8 cm long, turning white or tinged red, the margin with 2(–4) conspicuous teeth. *Drupe* much shorter than the cupule, subglobose to broadly elliptic or ovate, somewhat compressed laterally, 2–2.5 by 1.7–2.2 cm, dark brown, or black, faintly longitudinally 8-ribbed, abruptly tapering into a stalk 2–6 mm long, umbo absent. — **Fig. 4.**

Distribution — Mariana Is., Solomon Is.; in *Malesia*: scattered collections seen from Simeulue, Enggano (W of Sumatra), Java, Christmas I. (Indian Ocean), Philippines (Luzon), Celebes, Bali, Moluccas (Bacan, Sula I.), common in New Guinea (Irian Jaya):



Vogelkop, western and northern part, Japen I., near Jayapura; Papua New Guinea: Sepik, Madang, Morobe, Milne Bay Prov., New Britain, Woodlark I.).

Habitat & Ecology — Tree from lowland rain forest on coastal plains and alluvial flats; often on riverbanks, or ridges, also in old secondary forest, in hill forest and on steep mountain slopes; recorded from peaty soil, rocky clay, clay, and sandy clay. Found from sea level up to 1000 m altitude, but most collections are from the lowland.

Notes — 1. Kubitzki (1969) discussed the complicated typification of *H. ovigera*. He also noted that the present species seems to hybridize with *H. nymphaeifolia*, especially so in and near New Guinea.

2. Two collections from Christmas I. (Indian Ocean), *Powell 21* and *Mitchell 30*, show the cupules curiously and deceptively dissected but the phenomenon appeared artificial.

ILLIGERA

Illigera Blume, Bijdr. (1826) 1153; Hutch., Gen. Flow. Pl. 1 (1964) 145; Kubitzki, Bot. Jahrb. 89 (1969) 157; Kubitzki et al. (eds.), The families and genera of vascular plants 2, X (1993) 337. — Type species: *Illigera appendiculata* (lectotype, see Hutchinson 1964).

Henschelia Presl, Rel. Haenk. 2 (1835) 81, t. 63. — Type species: *Henschelia luzonensis* Presl.

Gronovia Blanco, Fl. Filip. (1837) 186. — Type species: *Gronovia ternata* Blanco.

Corysadenia Griff., Proc. Linn. Soc. 1 (1846) 281; Not. Pl. As. (1854) 356 ('*Coryzadenia*'). — Type species: *Corysadenia trifoliata* Griff.

Generally medium-sized woody climbers, climbing with the aid of twisted petioles. *Leaves* 3(–5)-foliolate, seldom simple and 3-lobed (not in Malesia); leaflets petioluled, top mostly acuminate, veins loop-like with midrib and lateral nerves curved towards apex or basal. *Inflorescence* terminal and axillary, many- or few-flowered; partial inflorescences cincinni, paired or simple, with bracts; bracts persistent (or caducous). *Flowers* bisexual, 5-merous, perianth segments (tepals) in two rows, valvate in bud, oblong, inner ones linear, deciduous; outer ones 3–5-nerved, inner ones 1–3-nerved; *ovary* ovoid, 4-angled, in fruit the angles grown out into 2 or 4 wings, style filiform; *stamens* 5, inserted opposite the outer tepals and alternating with sessile glands, or glands absent (*I. celebica*); filaments straight and slightly flattened, or inwardly coiled and conspicuously flattened, each at base with two inflated, membranous, shortly stiped appendages, or appendages clavate and solid; anthers ovoid. *Fruit* a samara; the nut with 2 longer and 2 shorter lateral wings (or wings sometimes absent), wings membranous, suborbicular or lingulate. *Seeds* with membranous testa; cotyledons free, more or less planoconvex, or slightly unequal.

Distribution — About 20 species, the majority in the Sinohimalayan region; in *Malesia* 9 species; in Africa and Madagascar 3 species.

Fig. 4. *Hernandia ovigera* L. a. Flowering twig; b. partial inflorescence, one male flower fallen off; c. female flower, cupule removed; d, e, f. inflated cupule; g. cupule and drupe seen from above; h. drupe (a, b: *Brass* 28620; c: *van Royen* 5096; d, h: *NGF* 7040; e, g: *BW* 358; f: *NGF* 4743). Reproduced with permission of Bot. Jahrb. 89 (1969).

Habitat & Ecology — Climbers in forests, or forest edges, in bushes and in thickets; some species in everwet regions, others in areas with periodical draught. Most species grow in the lower tropical zone, but in the Sinohimalayan region some may ascend up to 3300 m altitude.

KEY TO THE SPECIES

- 1a. Angle of lateral nerves with main nerve almost right, 80–90° **8. *I. pulchra***
- b. Angle of lateral nerves (basal nerves excepted), with main nerve much sharper, c. 30–60° 2
- 2a. Flower buds globose; stamens in bud and in young flower inwardly coiled, conspicuously protruding in anthesis; staminal appendages solid and clavate 3
- b. Flower buds ovoid or ellipsoid; stamens in bud straight or sigmoid, in young flowers straight, not or slightly protruding in anthesis; staminal appendages inflated and petaloid 4
- 3a. Filaments broad, tepal-like, at base 1.5–2.5 mm wide, the margins curved around the staminal appendages; interstaminal glands absent **2. *I. celebica***
- b. Filaments narrow, not tepal-like, at base c. 0.5 mm wide, the margins not curved around the staminal appendages; interstaminal glands present **7. *I. parviflora***
- 4a. Staminal appendages dorsally entire, not cleft 5
- b. Staminal appendages dorsally cleft 6
- 5a. Rim of staminal appendages conspicuously finger-like fringed, the fringes c. 0.5 mm long, inner perianth segments narrow, much narrower than outer perianth segments, c. 0.8 mm wide. Christmas I. (Indian Ocean) **3. *I. elegans***
- b. Rim of staminal appendages with short fringes, c. 0.2 mm long; inner perianth segments about as wide as outer segments, c. 2 mm wide. Papua New Guinea **6. *I. novoguineensis***
- 6a. Fruit wings lingulate, 3.5–6 cm long **5. *I. megaptera***
- b. Fruit wings hemi-orbicular, or sublingulate, 1.5–4 cm long 7
- 7a. Staminal appendages pointed at the top, not curved; perianth segments c. 2 mm acuminate **1. *I. appendiculata***
- b. Staminal appendages spathe-like, more or less hooded towards outside; perianth segments acute, or c. 0.5 mm acuminate 8
- 8a. Flowers 10–12 mm long, subglabrous; leaves usually drying blackish-brown **4. *I. luzonensis***
- b. Flowers 7–9 mm long, hairy; leaves drying brown **9. *I. trifoliata***

1. *Illigera appendiculata* Blume

Illigera appendiculata Blume, Bijdr. (1826) 1153; Dunn, J. Linn. Soc. Bot. 38 (1908) 294; Backer, Bull. Jard. Bot. Buitenzorg II, 12 (1913) 19; Backer & Bakh. f., Fl. Java I (1964) 136; Kubitzki, Bot. Jahrb. 89 (1969) 164, f. 39. — Type: *Blume 1472* (L), Java.

Leaves: petiole 3–13 cm, petiolules 0.5–1.5 cm, brown villose; leaflets chartaceous to coriaceous, lanceolate, elliptic, or ovate (or obovate), 6–14 by 3–9 cm, apex faintly

acute or with an acumen 3–10 mm long, base cordate or rounded (or cuneate), upper surface dull, both surfaces glabrous or sparsely hairy, but nerves on lower surface, especially midrib, hairy, domatia present; nerves: 3–6 pairs (at an angle of c. 45° with the midrib). Thyrses brownish tomentose. *Flower buds* ellipsoid, 6–9 mm long, with short brown hairs. Bracteoles c. 2.5 by 1.5 mm. *Perianth* in anthesis greenish, tinged purplish or pinkish. Tepals acute, up to 2 mm acuminate, both sides with short brown hairs, especially so towards the top; outer tepals 9–11 by 2–4 mm, 5-nerved, inner ones 9–10 by c. 2.5 mm, 3-nerved. *Filaments* ± filiform, slightly hairy, c. 4 mm long; *staminal appendages* including the c. 0.5 mm long stipe 2–2.5 mm long, inflated, ventrally with a pointed apex, dorsally broadly cleft, rim slightly denticulate; interstaminal glands present. *Fruits* reddish in living plants, cinnamon-coloured when dry, nut 2.5–3 cm long, 4-winged, but only one pair fully developed, the other pair obsolete or ridge-like; wings lingulate (subsp. *appendiculata*) or hemi-orbicular (subsp. *stenoptera*).

Distribution — *Malesia*: Sumatra, E Kalimantan (Kutai), Java, SW Celebes, Kangean I., Lesser Sunda Islands (Lombok, Sumbawa, Flores, Timor); see also note 2 under subsp. *stenoptera*.

Note — There are two closely resembling subspecies, distinct by differences in the wings of the fruit.

KEY TO THE SUBSPECIES

- a. Wings of nut lingulate, 2–3.5 cm long a. subsp. **appendiculata**
 b. Wings of nut hemi-orbicular, c. 2.5 cm in diameter b. subsp. **stenoptera**

a. subsp. **appendiculata**

Fruit wings well developed, lingulate, very finely and regularly striated, 2–3 cm long. A good illustration is given by Kubitzki (l.c.: f. 39 II).

Distribution — *Malesia*: Sumatra, W Java.

Habitat & Ecology — Foothill forest, primary dryland forest on flat alluvial soil; 30–800 m altitude.

b. subsp. **stenoptera** Kubitzki

Illigera appendiculata Blume subsp. *stenoptera* Kubitzki, Bot. Jahrb. 89 (1969) 164, f. 39 VII. — Type: Sujarto 79 (L), Sumbawa.

Illigera dubia Span., Linnæa 15 (1841) 187. — Type: *Spanoghe* 22 (L holo), Timor.

Fruit wings well developed, hemi-orbicular, c. 2.5 cm in diameter, striated, but less finely and regularly as in subsp. *appendiculata*.

Distribution — *Malesia*: E Java? (no collections seen), Kangean I., Lesser Sunda Islands (Lombok, Sumbawa, Flores, Timor).

Habitat & Ecology — In primary monsoon forest, in semi-dry forest and in secondary forest; 400–900 m altitude.

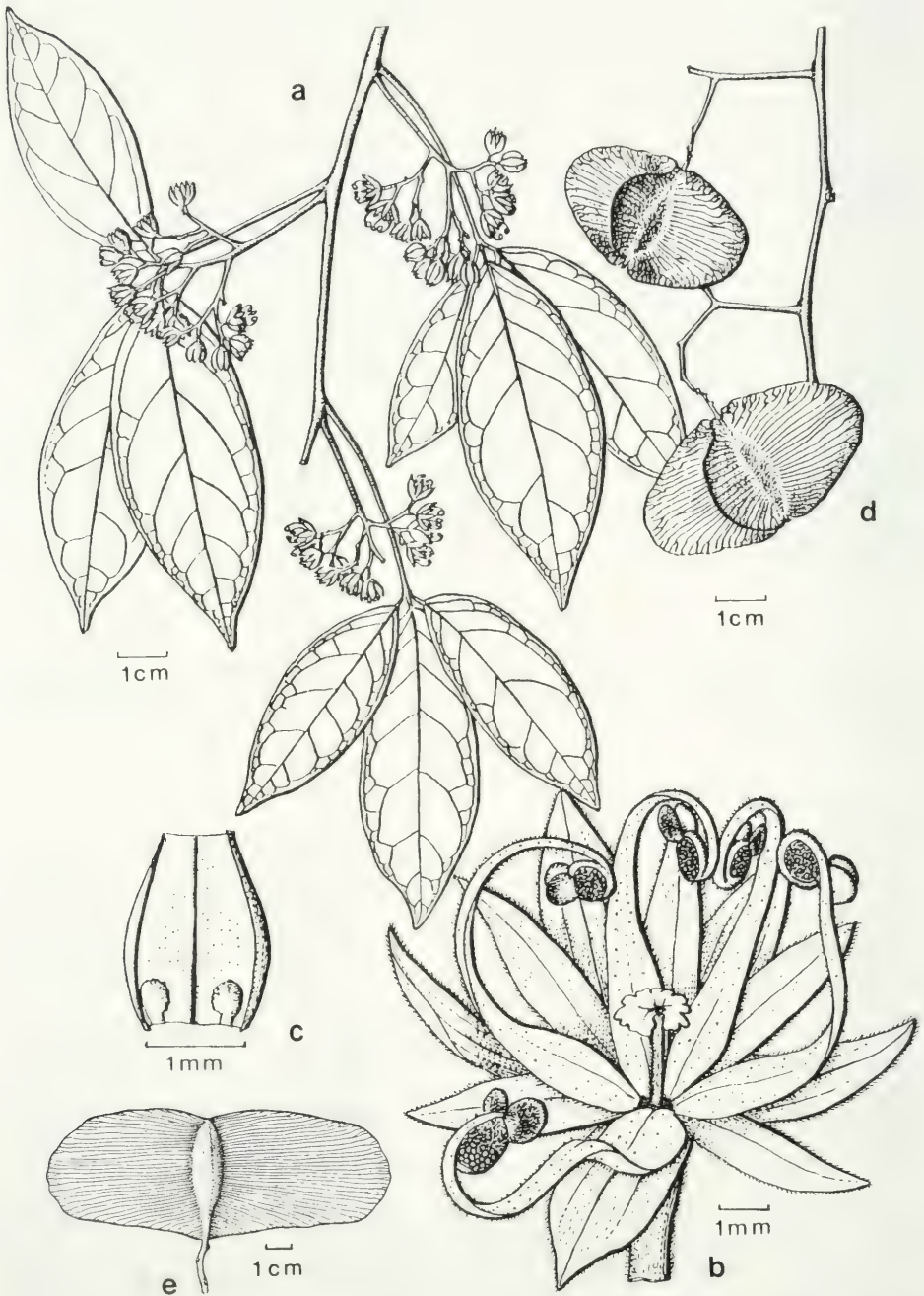


Fig. 5. *Illigera celebica* Miq. a. Flowering twig; b. flower; c. basal part of filament, showing staminal appendages; d. fruits. — *Illigera megaptera* Merr. e. Fruit (a, b, c: Ebalo 521; d: Tsang 26529; e: Elmer 13362). Reproduced (a–d) with permission of Bot. Jahrb. 89 (1969); e: drawing by J.H. van Os (L).

Notes — 1. *Illigera appendiculata* as a whole seems of rare occurrence: there are but a few recent collections. This was already observed by Backer (1913) for Java and by Schmutz for Sumbawa; the latter noted on the field label that he found the species only twice.

2. The only collections seen from East Kalimantan (*Endert 5140*, *Kostermans 6822*), as well as the one from Celebes (*Bünnemeijer 10580*), concern flowering specimens, and it cannot yet be decided to which subspecies they belong.

3. The majority of the herbarium collections concerns flowering material. Fruits of subsp. *appendiculata* are known only of two collections (Sumatra and W Java); subsp. *stenoptera* is known from three fruiting collections (Kangean I., Sumbawa and Flores) only, and more fruit-bearing material is needed to ascertain the status of the latter subspecies.

2. *Illigera celebica* Miq.

Illigera celebica Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 215; Merr., J. Str. Br. Roy. As. Soc. 85 (1922) 197; Koord., Suppl. Overz. Flora NO Celebes 2 (1922) 10; Merr., Pl. Elmer. Born. (1929) 91; Kubitzki, Bot. Jahrb. 89 (1969) 178, f. 44. — Type: *Forsten s.n.* (L), Celebes, Likupang, Sept. 1840.

Illigera platyandra Dunn, J. Linn. Soc. Bot. 38 (1908) 296; Gagnep. in Fl. Gén. Indo-Chine 2 (1920) 785; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 206. — Type: *Balansa 3161* (L), Tonkin.

Illigera ovatifolia Quisumb. & Merr., Philipp. J. Sc. 37 (1928) 149, p.p., quoad specim. *BS 47166* (K).

Leaves: petiole 4–11.5 cm, petiolules 1–2.5 cm, glabrous or partly palish hairy; leaflets thinly or thickly chartaceous, lanceolate or lanceolate-ovate, 7–17 by 2–8.5 cm, acumens 0.5–1 cm long, base cuneate or subcordate, glabrous on both surfaces, conspicuously olivaceous when dry, often shining above, nerves on lower surface glabrous or hairy, domatia absent, nerves: 4–7 per side, at angles of 40–60° with midrib and arching towards the apex; thyrses slightly pubescent. *Flower buds* globose, 2–5 mm in diameter; stamens in bud inwardly coiled. Bracteoles early falling, c. 1.5 by 0.5 mm. *Perianth*: green, white, pinkish, or violet, all parts more or less hairy (see note 1); tepals lanceolate, acute, outer ones 5–7 by c. 2 mm, inner ones 4.5–6 by c. 1 mm. *Filaments* reddish, tepal-like, filiform towards apex, 10–13 mm long, dilated towards the base, 1.5–2.5 mm wide, margins curved around the staminal appendages; *staminal appendages* clavate, dorsally inserted on the bases of the broad filaments, c. 0.6 mm long; interstaminal glands absent. *Fruits* unequally 4-winged, nut 2–3.3 cm long; longer wings lingulate, 2–2.7 cm long, shorter ones 1–1.4 cm long. — **Fig. 5a–d.**

Distribution — S China, Honkong, Thailand, N & S Vietnam; in *Malesia*: Borneo (Sabah, NE Kalimantan), Celebes, Philippines (Luzon, Palawan, Cebu), NW Irian Jaya.

Habitat & Ecology — Steep slopes in rain forest, disturbed and secondary forest, on riverbanks, in thickets, shrubs and underwood; on sand, limestone and ultrabasic rock; sea level up to 1000 m (Mt Kinabalu).

Notes — 1. The outer surface of the inner perianth segments is conspicuously white because of a thick, felt-like layer of short hairs, easily to be seen in herbarium specimens. The base of the inner perianth segments is much narrower than the base of the filaments.

2. Most of the herbarium material is in flower, while fruit-bearing specimens are under-represented.

3. *Illigera elegans* Duyfjes

Illigera elegans Duyfjes, *Blumea* 38 (1994) 407. — Type: *Powell 541* (K holo).

Creeper or climber. *Leaves*: petiole c. 11 cm, glabrous; petiolules 2–2.5 cm, glabrous; leaflets chartaceous, suborbicular, 6–9 by 6–7.5 cm, acumen c. 0.5 cm long, base cuneate or cordate, dull and glabrous above, but upper nerves with short hairs, lower surface with domatia, lateral nerves 4 or 5 pairs, at angles of 20–40° with midrib. Thyrses hairy. *Flower buds* ovoid, c. 5 mm long; stamens in bud straight. Bracteoles c. 1 by 0.5 mm. Perianth colour not known, outer and inner tepals unequal, slightly hairy towards the tips, outer tepals ovate-lanceolate, c. 6.5 by 2 mm, c. 0.5 mm acuminate, inner ones much narrower, c. 5 by 0.8 mm acute. *Filaments* filiform, c. 3 mm long; *staminal appendages* dorsally not cleft, the rim finger-like fringed, 1.5 mm long including the 0.5 mm long stipe; interstaminal glands present. *Fruits* with two large wings and with two obsolete wings or ridges, nut 0.8–1 cm long; larger wings more or less hemi-orbicular, c. 2 cm in diameter, the short ones 0.2–0.7 cm wide.

Distribution — *Malesia*: Christmas I. (Indian Ocean), S of Java. Only few collections seen.

Habitat & Ecology — On cliffs and ridges, and in high marginal growth of railway; 180–220 m altitude.

Note — In Malesia both *I. elegans* and *I. novoguineensis* have staminal appendages which are dorsally uncleft; outside Malesia this character is only found in *I. madagascariensis* Perrier de la Bâthie [Kubitzki, *Bot. Jahrb.* 89 (1969) 159]. Kubitzki suggested that the uncleft staminal appendages in the group of species with petaloid and hollow staminal appendages would be a primitive character, supported by the disjunct distribution of the species concerned.

4. *Illigera luzonensis* (Presl) Merr.

Illigera luzonensis (Presl) Merr., Philipp. Gov. Lab. Bur. Bull. 17 (1904) 18; Fl. Manila (1912) 212; Sp. Blanc. (1918) 156; Enum. Philipp. Flow. Pl. 2 (1923) 205; Li, Fl. Taiwan (1976) 472; Kubitzki, *Bot. Jahrb.* 89 (1969) 163. — *Henschelia luzonensis* Presl, *Rel. Haenk.* 2 (1835) 81, t. 63. — Type: *Haenke 60* (B, W), Luzon.

Illigera meyeniana Kunth ex Walp. in Meyen, *Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur.* 19, Suppl. 1 (1843) 410. — Type: *Meyen s.n.*, 1831 (B), Manila.

Illigera ternata (Blanco) Dunn, *J. Linn. Soc. Bot.* 38 (1908) 294; Merr., Sp. Blanc. (1918) 156. — *Gro-novia ternata* Blanco, Fl. Filip. 1 (1837) 186. — *Halesia ternata* Blanco, Fl. Filip. 1 (1837) 399. — Type: not indicated, illustrative specimens: *Merrill, Sp. Blanc.* 297 & 663 (both L).

Illigera cardiophylla Merr., Philipp. J. Sc., Bot. 9 (1914) 292; Kubitzki, *Bot. Jahrb.* 89 (1969) 161, f. 38. — Type: *Fénix BS 4082* (lost); neotype: *Edaño BS 79156* (NY, chosen by Kubitzki, 1969).

Illigera pubescens Merr., Philipp. J. Sc., Bot. 9 (1914) 446. — Type: *Vanoverbergh 2135* (P), Bontoc.

Illigera reticulata Merr., Philipp. J. Sc., Bot. 9 (1914) 291. — Type: *Curran & Merritt FB 7761*, Luzon.

Illigera ovatifolia Quisumb. & Merr., Philipp. J. Sc. 37 (1928) 150, p.p., excl. *Ramos & Edaño BS 47166* (= *I. celebica*, K). — Type: *BS 46712* (BM), Luzon.

Leaves: petiole 4–12 cm, petiolules 0.5–3 cm, glabrous or velutinous; leaflets thinly chartaceous or chartaceous, (sub)orbicular, or ovate, 4–13 by 3–10.5 cm, acute or with an 0.5–1 cm long acumens, base truncate, cordate, or cuneate, the upper surface drying (blackish) brown, the lower surface conspicuously paler, both surfaces glabrous or (sparsely) hairy, especially the midrib; domatia sometimes present; lateral nerves 3–5 pairs, at angles of c. 30° with the midrib; leaflets of flowering lateral shoots smaller, 4–7 by 2.5–5.5 cm, ovate or suborbicular with base almost rounded (rarely subcuneate). Thyrses glabrous or towards the flowers (and fruits) velutinous. *Flower buds* ovoid or ellipsoid, (5–)8 mm long. Bracteoles 1.5–2 by 0.8–1 mm, glabrous or velutinous. *Perianth* in anthesis green or pale pink, glabrous or somewhat hairy; inner and outer tepals slightly unequal, outer tepals lanceolate, 10–12.5 by 3–4 mm, acute or 0.5 mm mucronate, inner ones 9–11 by 2.5–3 mm, narrow at the base. *Filaments* ± filiform, 7–7.5 mm long; *staminal appendages* inflated, spathe-like, dorsally cleft, including the 0.5–1 mm long stipe 2.5–3.5 mm long; interstaminal glands present. *Fruits* with 2 large wings and with (one or) two obsolete wings or ridges; nut 1.5–3.5 cm long, wings variable, hemi-orbicular or sublingulate, longer wings 1.5–2.5 cm long, shorter ones 0.5(–1) cm long.

Distribution — Taiwan and southern Ryukyu Islands; in *Malesia*: Philippines (Babuyan Is., Luzon, Palawan, Mindoro, Samar).

Habitat & Ecology — Mountain and ridge slopes, also in secondary growth and forest plantations; altitude sea level to c. 1300 m.

Notes — 1. A remarkable character is the colour of the dried leaves: upper surface black-brown, lower surface contrastingly lighter. The comparatively rather large flowers are noteworthy.

2. The sterile collection *PNH 19128* (Mindoro) is somewhat deviating, with both leaf surfaces with rather long hairs.

5. *Illigera megaptera* Merr.

Illigera megaptera Merr., Philipp. J. Sc., Bot. 9 (1914) 290; Enum. Philipp. Flow. Pl. 2 (1923) 206; Kubitzki, Bot. Jahrb. 89 (1969) 170. — Type: *BS 21511* (K), Mindanao.

Illigera elliptifolia Merr., Philipp. J. Sc., Bot. 9 (1914) 291. — Type: *FB 20571* (US), Miranda.

Illigera diptera Elmer, Leaflet Philipp. Bot. 7 (1915) 2687. — Type: *Elmer 13362* (B, F, L, NY, U, UC, US, W), Cabadbaran.

Leaves: petiole 6–10.5 cm; petiolules 0.7–2.5 cm, glabrous or sparsely set with short hairs; leaflets chartaceous or coriaceous, ovate or oblong, 8–18 by 5.5–11 cm, acumens up to 1 cm long, base cordate or rounded, upper surface shiny or dull, lower surface dull, glabrous on both surfaces or lower midrib somewhat hairy towards the base, nerves 4 or 5 pairs, at angles of 60–80° with the midrib; domatia present or absent. Thyrses velutinous, especially near flowers and fruits, or partly glabrous. *Flower buds* ellipsoid, c. 6 by 4 mm. Bracteoles coriaceous, ovate, 2–5.5 by 1.2–3 mm, rusty velutinous on both surfaces. *Perianth* in anthesis pink, outer and inner tepals unequal, mucronate, outer surface hairy, especially towards the tips; outer tepals lanceolate, 7–10.5 by 3–3.5 mm, 5-nerved, inner ones spatulate, 6.5–9 by 2–2.5 mm, 3-nerved.

Filaments \pm filiform, c. 7 mm long; *staminal appendages* inflated, spathe-like, dorsally cleft, nearly to the base, including the c. 1 mm long stipe 2.5–3 mm long; interstaminal appendages present. *Fruits* with 2 wings and 2 ridges; nut 3–4 cm long, wings lingu-late, 3.5–6 cm long. — **Fig. 5e.**

Distribution — *Malesia*: Borneo (Sabah), Philippines (Luzon, Mindoro, Samar, Min-danao).

Habitat & Ecology — Recorded as a large liana of slopes, ridges and steep forested valleys; also in disturbed forest. Altitude 20–600(–1660) m; see note 4.

Notes — 1. Apparently a rare species and seldom collected in flower. Merrill (1914) described fruits only. I have seen only two collections with flowers: *Ridsdale 1171* (im-mature flowers, Mindoro) and *Nordin Abas SAN 85879* (Sabah).

2. Kubitzki (1969) regarded the presence or absence of domatia taxonomically an im-portant character; I found that they are mostly absent in *I. megaptera* from the Philip-pines, but in the Sabah material they are present.

3. *Illigera megaptera* resembles *I. luzonensis*, the latter differs e.g. by shorter leaflets and shorter fruit wings (hemi-orbicular or sublingulate).

4. Doubtful specimens are *Clemens 26185* and *51587*, both from Mt Kinabalu, with flowers only. Their resemblance in habit with *I. megaptera* is evident, so I named them provisionally under that species, although fruits are unknown. Their provenance, from an exceptionally high altitude, c. 1700 m, urged Kubitzki (1969) to place these two Clemens specimens under *I. khasiana* Clarke, a species from mountainous continental SE Asia. To me this seems unlikely, and more complete material from Mt Kinabalu is needed for a final decision.

6. *Illigera novoguineensis* Kubitzki

Illigera novoguineensis Kubitzki, Bot. Jahrb. 89 (1969) 161, f. 37 v. — Type: *Nyman 258* (B, C, S), Papua New Guinea, Madang.

Illigera appendiculata auct. non Blume: K. Schum. & Lauterb., Fl. Deutsch. Schutzgeb. Südsee (1900) 335.

Leaves: petiole 4–11 cm, petiolules 0.7–2.2 cm, pubescent; leaflets chartaceous, ovate to elliptic, 5–10 by 3–7.5 cm, acumen 0.3–0.7 cm long, base cuneate, subcordate or rounded, upper surface glabrous or slightly pubescent, the midrib shortly and densely hairy, lower surface laxly pilose; domatia present; nerves 3–4(–5) pairs at angles of 40–60° with midrib. Thyrses slightly pubescent. *Flower buds* ovoid, pear-shaped just before anthesis, 3–4 mm long. Bracteoles c. 1.5 by 0.5 mm. *Perianth* colour unknown; tepals all more or less equal, outer tepals ovate, c. 6 by 2.2 mm, 5-nerved, slightly hairy towards the tips, inner ones c. 5 by 2 mm, 3-nerved. *Filaments* \pm filiform, glabrous, c. 3 mm long; *staminal appendages* dorsally not cleft, urceolate, rim very shortly (c. 0.2 mm) fringed, including the c. 0.3 mm long stipe, c. 1.5 mm long; interstaminal glands present. *Fruits* greyish brown, 2-winged and (1- or) 2-ridged; nut c. 2 cm long, wings hemi-orbicular, 2–2.5 cm diam., ridges c. 0.7 cm long.

Distribution — *Malesia*: Papua New Guinea (Madang Prov., S of Madang).

Habitat & Ecology — Rain forest; up to 700 m altitude.

Notes — 1. Only three collections known, all collected round 1900.

2. The species is strongly resembling *I. appendiculata*, but the staminal appendages are different: not fissured in *I. novoguineensis* and dorsally fissured in *I. appendiculata*. See also the note under *I. elegans*.

7. *Illigera parviflora* Dunn

Illigera parviflora Dunn, J. Linn. Soc. Bot. 38 (1908) 296; Kubitzki, Bot. Jahrb. 89 (1969) 177; Ng in Tree Fl. Malaya 2 (1973) 247. — Type: Ford 260 (K), Kwantung.

Illigera appendiculata auct. non Blume: Ridley, Fl. Malay Penins. 3 (1924) 139, f. 146.

Illigera lucida auct. non Teijsm. & Binnend.: M.R. Hend., Gard. Bull. Str. Settl. 4 (1926) 102.

Leaves: petiole 8–9 cm; petiolules 1.5–2 cm, glabrous or with some hairs; leaflets chartaceous, ovate or lanceolate, 7–11 by 3.5–6.5 cm, acumen c. 0.5 cm long, base cuneate or rounded; drying brownish, upper surface dull, glabrous, lower surface with short hairs on midrib, lateral nerves c. 4 pairs, at angles of 30–45° with midrib. Thyrses densely pubescent. *Flower buds* globose, 2–3 mm diam.; stamens in bud inwardly coiled. *Perianth* in anthesis white; tepals unequal, acute, with short hairs towards the tips, outer tepals ovate 3.2–4 by c. 2.2 mm, 3–5-nerved, inner ones lanceolate, 3–3.2 by c. 1 mm, at base narrow, c. 0.4 mm wide, 3-nerved. *Filaments* ± filiform, 4.5–6 mm long, at base c. 0.5 mm wide, protruding; *staminal appendages* very inconspicuous, clavate, including stipe 0.3–0.6 mm long; interstaminal glands present, small. *Fruits* unequally 4-winged, nut 2–3 cm long; longer wings more or less hemi-orbicular, c. 2 cm long, shorter ones c. 0.5 cm long.

Distribution — China, Vietnam; in *Malesia*: Peninsular Malaysia (Perak, Pahang).

Habitat & Ecology — Lowland forest, in underwood and thickets and in mountainous places in open wood; up to 1260 m altitude.

8. *Illigera pulchra* Blume

Illigera pulchra Blume, Bijdr. (1826) 1154; Backer & Bakh. f., Fl. Java 1 (1964) 136; Kubitzki, Bot.

Jahrb. 89 (1969) 174, f. 42; Ng in Tree Fl. Malaya 2 (1973) 247. — Type: *Blume s.n.* (L), Java.

Illigera lucida Teijsm. & Binnend., Nat. Tijds. Ned. Ind. 27 (1864) 29; Kurz, Nat. Tijds. Ned. Ind. 27 (1864) 168; Ridley, Fl. Malay Penins. 3 (1924) 140. — Type: *Teijsmann s.n.* (BM), Bangka.

Leaves: petiole 4–8 cm; petiolules 0.5–1.3 cm; glabrous or partially hairy; leaflets thickly chartaceous, lanceolate or elliptical, 5–15 by 2–5 cm, acumen 0.3–1.5 cm long, base rounded or cordate, glabrous on both surfaces or slightly hairy on the lower surface, upper surface shiny, olivaceous when dry; nerves 7–9(–15) pairs, looped, at angles of 80–90° with midrib. Thyrses slightly pubescent. *Flower buds* subglobose, ovoid, or pear-shaped, 3–5 mm long. Bracteoles c. 1.5 by 0.5 mm. *Perianth* in anthesis: outer and inner tepals unequal, inner surface towards the base with palish c. 1 mm long hairs; outer tepals ovate or lanceolate, connate at base, 6–6.5 by 2–2.5 mm, inner ones linear, 5–6 by 0.6–0.8 mm. *Filaments* ± filiform, c. 2 mm long, with c. 1 mm long hairs in the lower part; *staminal appendages* inconspicuous, solid, clavate, c. 0.25 mm long; interstaminal glands present. *Fruits* 2-winged and 2-ridged, nut 1.5–2.5 cm long; wings lingulate, 3–3.7 cm long, ridges c. 0.5 cm long.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Bangka, W Java, Celebes (see note).

Habitat & Ecology — Lowland forest, in bushes and thickets; often on limestone; up to c. 100 m altitude.

Note — Kubitzki (1969) mentioned for its provenance also Celebes (Sulawesi), but I have seen no collections. Apparently a rare species; there are no collections made after the 1930s.

9. *Illigera trifoliata* (Griff.) Dunn

Illigera trifoliata (Griff.) Dunn, J. Linn. Soc. Bot. 38 (1908) 294; Kubitzki, Bot. Jahrb. 89 (1969) 169; Ng in Tree Fl. Malaya 2 (1973) 247, f. 3. — *Corysadenia trifoliata* Griff., Not. Pl. As. 4 (1854) 356.

Illigera corysadenia Meisn. in A. DC., Prodr. 15, 1 (1864) 251. — Type: *Griffith s.n.* (K), Madamaca I., Mergui Archipel.

Illigera dasyphylla Miq., Fl. Ind. Bat. 1, 1 (1858) 169; *ibid.*, Suppl. (1861) 333, t. 1. — *Illigera trifoliata* var. *dasyphylla* (Miq.) Kubitzki, Bot. Jahrb. 89 (1969) 169. — Type: *Teijsmann H.B.* 1036 (BO, L, U), Sumatra, Solok.

Illigera kurzii Clarke in Hook. f., Fl. Brit. India 2 (1878) 460. — Type: *Maingay 649* (K), Malay Peninsula.

Illigera appendiculata auct. non Blume: Kanjilal c.s., Fl. Assam 4 (1940) 103; M.R. Hend., Malayan Wild Flow. Dicot. 1 (1959) 445, f. 402.

Strong climber or creeper. *Leaves*: petioles 8–10 cm, petiolules 0.8–2 cm, slightly or densely hairy; leaflets chartaceous, ovate, 5–15 by 3.5–8 cm, apex acute, base rounded or cordate, upper surface glabrous or sparsely hairy in many gradations, and often with short hairs on the nerves, the lower surface hairy in many gradations: only sparsely hairy, especially on and near the nerves; domatia present; nerves curved, c. 6 pairs, at angles of 60–80° with midrib. Thyrses velutinous. *Flower buds* ovoid, 4.5–5 mm long. Bracteoles c. 2 by 1 mm. *Perianth* in anthesis with tepals pinkish white or pale greenish with purplish midnerve; outer and inner tepals unequal, outer surface densely hairy or (somewhat) hairy towards the tips only, acute, outer tepals 6.5–9 by 1.8–2 mm, inner ones 5–7 by 0.5–1.8 mm, at the base c. 0.5 mm wide. *Filaments* filiform, somewhat papillose, 6–6.5 mm long; *staminal appendages* inflated, spathe-like with an entire rim, dorsally cleft, including the 0.5–1 mm long stipe 2–3 mm long; interstaminal glands present. *Fruits* cinnamon-coloured when dry, 2-winged and with 2 ridges, often with short hairs; nut 3–4 cm long; wings lingulate, 3.5–4 cm long, the ridges c. 0.2 cm.

Distribution — Andaman Islands, Laos, Thailand; in *Malesia*: Sumatra, Peninsular Malaysia (Perak, Selangor).

Habitat & Ecology — Margins of evergreen forest, forest edges in open sunny places, in ravines, also in secondary growth such as roadsides, etc. Found on loamy soil and granite bedrock. Altitude 100–800(–1050, Thailand) m.

Note — The indumentum of the leaves is very variable. Older stems may reach a diameter of c. 1.5 cm, with scaly bark (*Maxwell 10-8755*, Thailand).

Postscript

EMBRYOLOGY AND TAXONOMIC POSITION OF HERNANDIACEAE

A recent study (Heo & Tobe 1995) on the embryology of *Gyrocarpus* (*G. jatrophifolius*) and *Hernandia* (*H. cordigera*, *H. nymphaeifolia*) disclosed that no synapomorphies exist for these two genera. They are rather divergent in various characters, which supports the prevalent acceptance of two subfamilies in the *Hernandiaceae*: a derived subfamily *Hernandioideae* and a less specialized subfamily *Gyrocarpoideae* (see under Taxonomy, page 738). Nevertheless, *Hernandiaceae* evidently is one separate family belonging in the *Laurales*, because both *Gyrocarpus* and *Hernandia* share various synapomorphies with other lauralian families, as was also previously supported by cladistic and DNA analyses. However, embryologically no evidence was found to separate *Hernandiaceae* from *Lauraceae*, whereas the genus *Hernandia* shares two synapomorphies with the latter family, viz. pachychalazy (ramified raphal vascular bundles at the chalaza) and ruminant cotyledons.

Reference: Heo, K. & H. Tobe, Embryology and relationships of *Gyrocarpus* and *Hernandia* (*Hernandiaceae*), J. Plant Res. 108 (1995) 327.

LOWIACEAE

(Kai Larsen, Aarhus)¹

Lowiaceae Ridley, Fl. Malay Penins. 4 (1924) 291.

Perennial, glabrous *herbs* without aerial stem, often tufted from a horizontal or vertical, sympodial rhizome bearing scale-like leaves. *Leaves* distichous, glabrous, eligulate, base sheathing, petiole well-defined, lamina entire, lanceolate, dorsiventral, enrolled in bud; venation pinnate-parallel with the secondary veins emerging from the prominent main vein at narrowly acute angles and regularly connected by fine transversal veins (conspicuous in dried material, but not in living plants). *Inflorescence* dense or lax, consisting of irregularly branching monochasial cymes. *Flowers* bracteate, bisexual, epigynous, with the ovary prolonged into a solid extension. *Sepals* (outer tepals) 3, subequal, narrow, fused basally into a tube. *Petals* (inner tepals) 3, very unequal, the two lateral small, narrow, the median large, forming a variously shaped labellum. *Stamens* 5, free from each other, the upper median reduced; filaments short, adnate to the base of the petals; anthers tetrasporangiate, introrse, opening by long slits, apically terminated by a short connective tip. *Gynoecium* of 3 fused carpels, with septal nectaries and axile placentae; style elongate, widening apically; stigmatic lobes 3, large, simple undivided or flattened, laciniate-fimbriate, wet. *Ovules* numerous, anatropous, bitegmie, crassinucellate. *Fruit* a dry, loculicidal, elongate capsule terminated by a beak formed by the proximal part of the ovary extension. *Seeds* numerous, globose, hairy, endospermous, with a lacerate aril and an operculum opposite the radicle.

DISTRIBUTION

There is only one genus, *Orchidantha*. For the distribution, see there.

TAXONOMY

The systematic position of the *Lowiaceae* is undisputed; since its establishment it has been recognized as belonging to the order *Zingiberales*.

The only genus *Orchidantha* was described by N.E. Brown, who published *O. borneensis* on 23 October 1886 in a note titled "A new genus of *Scitamineae*." He stated: "for the present I place it in the *Museae*." The plant was introduced from Borneo without indication of locality and grown at Ghent, Belgium.

On the 25th of October of the same year Scortechini published *Lowia* as a new genus from the Malay Peninsula based on *L. longiflora* from Perak. Also he referred it to the tribe *Museae*, regarding it as closely related to *Heliconia*. On account of the developed labellum he suggested it being a link between *Museae* and *Zingibereae*.

1) With contributions by R.W. J.M. van der Ham, Leiden (palynology) and R. Hegnauer, Leiden (phytochemistry).

In 1893 Ridley published *Protamomum maxillarioides*, also from the Malay Peninsula. He knew of Scortechini's description, but not of Brown's, and recognized his genus as belonging to the same group as *Lowia*; he proposed the family name *Lowiaceae*, without any formal description.

In 1897 K. Schumann treated the group under *Musaceae* as *Lowieae* in Engler & Prantl, Nat. Pflanzenfamilien, and as *Lowioideae* in Das Pflanzenreich three years later. H. Winkler followed him in the second edition of Engler & Prantl's Pflanzenfamilien (1930). Ridley established the family in 1924, in 1941 T. Nakai [J. Jap. Bot. 17 (1941) 201, in key] added a Latin diagnosis. All subsequent authors have recognized the family with only one genus, *Orchidantha*. See also Cronquist (1980).

Cladistic analyses undertaken by Dahlgren et al. (1985), Kress (1990) and Smith et al. (1993), all using different outgroups, show its relationship to the group of families related to *Musaceae*, rather than to the *Zingiberaceae*–*Marantaceae* group, and are thus in full agreement with the observations and conclusions of Brown. The study by Smith et al. (1993) involved the analysis of chloroplast DNA of *Orchidantha fimbriata* and *O. siamensis*.

The most striking character of the family is the enlargement of the median petal to a labellum as in the orchids, hence the name *Orchidantha*. However, little is known about the family. To quote Kress (1990): "The *Lowiaceae* are among the most poorly known taxa in the order in terms of taxonomy, general morphology, embryology, chemistry, and ecology."

References: Cronquist, A., An integrated system of the classification of flowering plants (1980). — Dahlgren, R.M.T., H.T. Clifford & P.F. Yeo, The families of the Monocotyledons: structure, evolution, and taxonomy (1985). — Kress, W.J., The phylogeny and classification of the Zingiberales. Ann. Missouri Bot. Gard. 77 (1990) 698. — Smith, J.F., W.J. Kress & E.A. Zimmer, Phylogenetic analysis of the Zingiberales based on *rbcl* sequences. Ann. Missouri Bot. Gard. 80 (1993) 620.

MORPHOLOGY

The distal partial inflorescences of *Orchidantha siamensis* consist of a bract subtending a branch with a basal prophyll and three bracts, the uppermost of which subtends a flower bud, the next from the apex subtends a branch of a similar construction; the axis continues beyond the uppermost flower bud (pers. obs.). Holttum in his analysis of *O. longiflora* [Gard. Bull. Sing. 25 (1970) 239] described the flower as truly terminal. He also observed from old inflorescences a succession of scars where the flowers had fallen, with two bract scars between each; he concluded that the cyme is close to being a cincinnus. The bracts are all more or less tubular at base and their orientation is not easy to establish.

The ovary has an apical prolongation which is sometimes called a calyx tube or hypanthium. It is, however, solid with a central vascular strand connecting the base of the style with the ovary; here the term ovary extension, introduced by Holttum, has been used. The sepals (or outer tepals) are similar; the petals (or inner tepals) are arranged as in an orchid flower with two lateral petals and a labellum. The flower is resupinate. The lateral petals are small and overlap the stamens; the labellum is variously shaped, in some species having a narrower proximal part and a broad distal part, in other species

(e.g. *O. holttumii*) the whole labellum is rather broad but distally curved back and forming a claw-like structure. The labellum often has lamellae along the vascular strands. These parts may play a role in pollination.

ANATOMY

The roots are relatively thick and air channels are present. Vessels are present in the roots only and have scalariform perforation plates with numerous bars. The rhizomes are rich in small, angular starch grains quite different from those found in *Musaceae* and *Strelitziaceae*. The chlorenchyma of the lamina is without a palisade layer and consists of an irregular mixture of small and large cells. The leaf axis includes two distinct systems of narrow air canals. Stomata are paracytic with deeply sunken subsidiary cells. Stegmata are present in the form of 'hat-shaped' silica-bodies. Raphide sacs are common, especially in the rhizome. Crystals of calcium oxalate are found in all parts. Tannins occur only in the rhizome.

All in all *Lowiaceae* are anatomically very different from the other families in *Zingiberales*.

Literature. Tomlinson, P.B., in C.R. Metcalfe (ed.), *Anatomy of the Monocotyledons 3, Commelinales-Zingiberales* (1969).

POLLINATION BIOLOGY

Very little is known about the pollination. The flowers of *Orchidantha fimbriatum* have a foul smell (Corner writes on a label that they smell of "bugs and coconut-oil"). The labellum is white and placed close to the soil, and the succulent central part along the midvein contains cells with nutritious tissue, protein cells. Kress (pers. comm.) reports that the labellum is eaten during the night; he suggests that small primatess, tree shrews (*Tupaiaidae*), feed on the labellum then. *Orchidantha holttumii*, on the other hand, has purple flowers smelling of horse-dung (Boyce) or fish (Dransfield), and the labellum is erect during anthesis. This species may be pollinated by flies.

PHYTOCHEMISTRY

(R. Hegnauer)

Formerly *Lowioideae* (*Orchidantha*), *Strelitzioideae* (including *Heliconiaceae* 3 or 4 genera) and *Musoideae* (1–3 genera) formed one family, *Musaceae* s.l. As the chemistry of all these taxa is rather poorly known at present, some general remarks about chemical characters of *Musaceae* s.l. seem to be appropriate here. For recent reviews see Tomlinson (1959, 1969), Hegnauer (1963, 1986) and Dahlgren et al. (1985). It should be stressed that some of the important anatomical and chemical characters of *Musaceae* s.l. are intimately connected: structures of starch grains, crystals of calcium oxalate (raphides and other crystal-types), silica bodies located in longitudinal rows of specific silica-cells, called stegmata, and 'tannins' in ordinary parenchymatic cells or deposited in idioblasts or articulated lactifers with their mucilaginous tannin-like and

polyisoprenoid contents; rubber-like polyisoprenes seem to be restricted to *Musaceae* s.str. The tannins of *Musaceae* s.l. are of the condensed type; all seem to be proanthocyanidin oligo- and polymers yielding pelargonidin, cyanidin and/or delphinidin on treatment with mineralic acids. Serious chemical investigations are restricted to *Musaceae* s.str. apart from a flavonoid survey of *Zingiberales* by Williams & Harborne (1977); leaves of most representatives of *Musaceae* s.l. contained glycosides of the flavonols kaempferol and quercetin, but lacked glycosides of myricetin, flavones and C-glycoflavones; flavonoid content of leaves of *Orchidantha maxillarioides*, the only investigated taxon belonging to *Lowiaceae*, was so low that no positive identifications were possible. According to Tomlinson proanthocyanidins are restricted in *Lowiaceae* to subterranean parts. Remarkable observations were published recently for bananas (*Musa acuminata*, *M. × paradisiaca*). Fruits of vegetable varieties of banana are used in India as anti-ulcerogenic medicine; the active principles were reported to be acylated (16:0; 18:1) 3-glycosidic derivatives of sitosterol, called sitoindosides I to IV (Ghosal & Saini 1984; Ghosal 1985). *Musa acuminata* 'Giant Cavendish', has *Colletotrichum musae*-resistant fruits; unripe fruits were shown to produce the phenalenone-type phytoalexin 2-(4'-hydroxyphenyl)-naphthalic anhydride after infection with conidia of this pathogen (Hirai et al. 1994). A year before Luis et al. (1993) had isolated two phenalenones, irenolone and emenolone, from banana leaves infected with *Mycosphaerella fidjiensis*. It is noteworthy that these phytoalexins strongly remind the yellow to red pigments of *Haemodoraceae* (see Flora Malesiana I, 11: 357 and Hegnauer 1986: 659). Tomlinson stressed the fact that from an anatomical point of view *Lowioideae* have an isolated position within *Musaceae* s.l.; one argument is based on the structure of their rather small and often composite starch grains which strongly deviate from the zingiberalean type present in the rest of *Musaceae* s.l. Other pleas for family status of *Lowiaceae* are based on epicuticular leaf waxes which are lacking in *Orchidantha*, but are represented in all other investigated *Musaceae* s.l. by the so-called *Strelitzia*-type (Fröhlich & Barthlott 1988), and by a low diameter of their sieve-element plastides which belong to the P2cs-type (i.e. containing cuneate protein crystals and starch grains) in all *Zingiberales* (Behnke 1994). Chemically the *Strelitzia*-type wax rodlets of *Musaceae* are composed predominantly of wax esters which are accompanied by alkanes, alkanols, alkanals and free fatty acids; triterpenoids are lacking (*Heliconia*, *Strelitzia*) (Meusel et al. 1994).

References and remarks: Behnke, H.-D., Sieve-element plastides, nuclear crystals and phloem proteins in the Zingiberales, Bot. Acta 107 (1994) 3–11; investigated 2 *Heliconia* species, 5 *Musaceae* s.str., 3 *Strelitzia* species and *Orchidantha maxillarioides*. — Dahlgren, R.M.T., H.T. Clifford & P.F. Yeo, The families of the Monocotyledons (1985) 352–359; cyanogenic glycosides erroneously indicated on p. 355 for *Musaceae* s.str. and the statement that *Musaceae* s.str. produce 3-deoxyanthocyanidins is based on a preliminary report (no isolation; no structure elucidation) on reddish compounds in UV-irradiated fruits of *Musa* 'Dwarf Cavendish' by N.S. Singh, Influence of UV light on the biosynthesis of anthocyanin-like pigments in ripening bananas, Phytochemistry 11 (1972) 163–164. — Fröhlich, D. & W. Barthlott, Mikromorphologie der epicuticularen Wachse und das System der Monokotylen, Tropische und subtropische Pflanzenwelt 63 (1988) 1–134 (Akad. Wiss. Mainz); from *Lowiaceae* only *Orchidantha maxillarioides* investigated. — Ghosal, S., Phytochemistry 24 (1985) 1807–1810. — Ghosal, S. & K.S. Saini, J. Chem. Research (S) (1984) 110. — Hegnauer, R., Chemotaxonomie der Pflanzen 2 (1963) 362–371, 490; 7 (1986) 557 (proanthocyanidins of monocots), 596 (flavonoids of

leaves of *Zingiberales*), 733–735, 596 (*Musaceae* s.l.). — Hirai, N., et al., *Phytochemistry* 37 (1994) 383–385. — Luis, J.G., et al., *J. Org. Chem.* 58 (1993) 4306–4308. These authors used leaves and green fruits of *Musa paradisiaca* ‘Grand Dwarf’ and ‘Valery’. Infected leaves yielded largest amounts of phytoalexins. According to Luis et al. banana phenalenone-phytoalexins are biogenetically different from phenalenone-pigments of *Haemodoraceae*. If this assumption turns out to be true, the two types of phenalenones are analogous, not homologous metabolites. — Meusel, I., et al., Chemistry and micro-morphology of compound epicuticular wax crystalloids (*Strelitzia*-type), *Pl. Syst. Evol.* 193 (1994) 115–123. — Tomlinson, P.B., An anatomical approach to the classification of *Musaceae*, *J. Linn. Soc. London (Bot.)* 55 (1959) 779–809. — Tomlinson, P.B., in C.R. Metcalfe (ed.), *Anatomy of the Monocotyledons. Vol. 3. Commelinales–Zingiberales* (1969) 303–340 (also figures of starch grains: *Musaceae* p. 306, *Heliconiaceae* p. 320, *Orchidantha longiflora* p. 339). — Williams, Ch.A. & J.B. Harborne, *Biochem. Syst. Ecol.* 5 (1977) 221–229.

PALYNOLOGY

(R.W.J.M. van der Ham)

Little is known about the pollen morphology of the *Lowiaceae*. Winkler (1930) and Erdtman (1952) described the pollen grains of *Orchidantha* as spheroidal and psilate. According to Lane (1955) the pollen is ‘granular’ and very large. Kress (1986, 1990) implicitly described *Lowiaceae* pollen as inaperturate (functionally omniaperturate), with a reduced, non-stratified, poorly sculptured exine and an elaborated, stratified intine. Such pollen is ubiquitous in the *Zingiberales*, and is probably a primitive character of the order.

Light microscopic observation of the pollen of *Orchidantha longiflora* (untreated material from specimen HBL 06527 in the Hortus Botanicus, Leiden) shows subspheroidal (long axis av. 165 µm, short axis av. 150 µm), inaperturate, psilate grains. The pollen wall is 4–6 µm thick and possibly completely intinous. It consists of a thick (1/2–4/5), densely radially striate outer layer (‘exintine’) and a usually thinner, homogeneous inner layer (‘endintine’).

References: Erdtman, G., Pollen morphology and plant taxonomy (1952). — Kress, W.J., *Linn. Soc. Symp. Ser.* 12 (1986) 329–345; *Ann. Missouri Bot. Gard.* 77 (1990) 698–721. — Lane, I.E., *Mitt. Bot. Staatssammlung München II* (1955) 114–131. — Winkler, H., in A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien*, ed. 2, 15a (1930) 505–541.

CHROMOSOMES

$2n = 18$ has been found in *Orchidantha maxillarioides* and *O. holttumii* by the author and in *O. siamensis* by C. Arthamas, Thailand (pers. comm.).

ORCHIDANTHA

Orchidantha N.E. Br., *Gard. Chron.*, n.s., 26 (1886) 519; Ridley, J. *Str. Br. Roy. As. Soc.* 32 (1899); *Fl. Malay Penins.* 4 (1924) 291; H.J.P. Winkl. in Engl. & Prantl, *Nat. Pflanzenfam.*, ed. 2, 15a (1930) 541; Holttum, *Gard. Bull. Sing.* 25 (1970) 239; K. Larsen, *Bot. Tidsskr.* 56 (1961) 348; in *Fl. Thailand* 2 (1972) 170, f. 10; in *Fl. Camb., Laos & Vietnam* 20 (1983) 147; Nordic J. Bot. 13 (1993) 285; Nakai, J. *Jap. Bot.* 17 (1941) 189; T.L. Wu, *Acta Phytotax. Sin.* 9 (1964) 343; T.L. Wu & S.-J. Chen in *Fl. Reip. Pop. Sinica* 16, 2 (1981) 19. — Type species: *Orchidantha borneensis* N.E. Br.

Lowia Scort., Nuov. Giord. Bot. Ital. 18 (1886) 308; Baker in Hook. f., Fl. Brit. India 6 (1892) 263; K. Schum. in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 1 (1897) 90. — Type species: *Lowia longiflora* Scort. [= *Orchidantha longiflora* (Scort.) Ridley].

Protamomum Ridley, Trans. Linn. Soc. Lond. II, 3 (1893) 383, t. 66. — Type species: *Protamomum maxillarioides* Ridley [= *Orchidantha maxillarioides* (Ridley) K. Schum.].

Description — For a description, see the family description.

Distribution — The ten species are distributed from southern tropical China (Kwangtung and Hainan), through Vietnam (1), Laos (1), and Thailand (1), in *Malesia* to West Malaysia and Borneo. It has frequently been reported in recent literature from 'Pacific islands'. This is probably due to an error.

Habitat & Ecology — The genus seems to be restricted to the lowest layer in lowland tropical forest, mostly evergreen rain forest, along streams and waterfalls, sometimes also in clearings after logging. The plants are light-requiring and often occur together with *Zingiberaceae*.

Notes — 1. The genus has no economic importance and is not often cultivated; *O. maxillarioides* is, however, often grown as a greenhouse plant.

2. Many species are known only from a few collections, or even from the type collection alone. The author has studied several populations of *O. siamensis* in nature in southern Peninsular Thailand. Future research should concentrate on inflorescence structure, pollination and dispersal biology.

KEY TO THE SPECIES

- 1a. Style with stigma 2.5–4.5 cm long 2
- b. Style with stigma not more than 1.6 cm long 4
- 2a. Stigma branches undivided **3. *O. holttumii***
- b. Stigma branches fimbriate 3
- 3a. Labellum 10–12 cm long, apical part 5 cm wide; sepals 11–14 cm long **2. *O. fimbriatum***
- b. Labellum c. 6 cm long, apical part c. 2.2 cm wide; sepals 6–6.5 cm long **6. *O. siamensis***
- 4a. Ovary 8–12 cm long including extension; sepals 6–10 cm long **4. *O. longiflora***
- b. Ovary 2–5.5 cm long including extension; sepals 2.5–3 cm 5
- 5a. Stigma lobes bilobed with a small tooth in the sinus; ovary c. 5.5 cm long including extension **5. *O. maxillarioides***
- b. Stigma lobes finely toothed; ovary 2–2.5 cm long including extension **1. *O. borneensis***

1. *Orchidantha borneensis* N.E. Br.

Orchidantha borneensis N.E. Br., Gard. Chron., n.s., 26 (1886) 519; Holttum, Gard. Bull. Sing. 25 (1970) 246. — Type: Cult. from Borneo (K holo), see note.

Leaves up to 50 cm long; petiole 10–25 cm long, terete in upper part; lamina broadly ovate to ovate lanceolate, acuminate, 15–25 by 6–9 cm. *Floral bracts* purplish. *Sepals*

pale yellowish with purple apex, linear-lanceolate, acuminate, 2.5–2.8 cm long. *Lateral petals* blackish violet, linear, truncate with a fine bristle at apex, c. 8 by 1.1 mm. *Labellum* blackish violet, c. 2 cm long, linear-lanceolate, acuminate. *Stamens* 5–6 mm long. *Ovary* 18 mm long including extension; style as long as stamens, slender, terete, whitish, terminating in a blackish violet, tripartite, fimbriate crest with a V-shaped stigma.

Distribution — *Malesia*: Borneo (more precise origin unknown).

Note — This is the most poorly known species. Only the specimen deposited in K is known. It originates from a cultivated plant introduced by the 'Compagnie Continentale d'Horticulture', Ghent, Belgium.

2. *Orchidantha fimbriata* Holttum

Orchidantha fimbriata Holttum, Gard. Bull. Sing. 25 (1970) 243, pl. 1. — Type: *Haniff 3957* (SING holo), Perak.

Leaves up to 130 cm long; petiole with sheath up to 30 cm long; lamina light green, up to 100 by 15 cm, base narrowly decurrent, margin undulate. *Inflorescence* little branched; prophyll c. 18 mm long; intermediate bracts up to 7 cm long; floral bracts dull purple, up to 15 cm. *Sepals* reflexed, 11–14 by 2 cm, gradually narrowed to the mucronate apex; margin strongly recurved during anthesis, later flattening, dark dull purple throughout or green with purple base. *Lateral petals* cream with dark purple tip and base, up to 27 by 6 mm, narrowly triangular, apex filiform. *Labellum* dark purple brown, 10–12 by 5 cm, narrow with inflexed sides at the base, widening abruptly beyond the stigma to a creamy white, irregularly grooved and folded lamina, towards apex usually 3-lobed; lateral lobes reflexed, middle lobe smaller and straight, texture rather fleshy, surface smooth and somewhat mucilaginous. *Stamens* 24 mm long; filaments 3 mm, flushed with purple; anthers cream coloured. *Ovary* purple, 12–20 mm long including extension, distal part 4 mm diam.; style c. 2 cm long, purplish, wiry; stigma c. 2.4 cm long, white at base, divided towards apex into 3 narrow, dark purple, shining lobes, distally fimbriate for 5–6 mm. *Fruit* c. 8.5 cm long including the extension. *Seeds* hairy, c. 10 mm long; aril lobes up to 15 mm long.

Distribution — *Malesia*: West Malaysia: Perak, Selangor, Pahang, Trengganu and S Johore.

3. *Orchidantha holttumii* K. Larsen — Fig. 1, 2

Orchidantha holttumii K. Larsen, Nordic J. Bot. 13 (1993) 285, f. 2, 3. — Type: *Poulsen et al.* 298 (AAU holo; BRUN, K), Brunei.

Robust *perennial* with distichous leaves. Roots numerous, robust, c. 3 mm diam., from a vertical rhizome, c. 15 mm diam., more than 6 cm long. The base of the plant surrounded by several narrow, purple leaf-sheaths 5–8 cm long. *Leaves* up to 150 cm long; petiole 30–70 cm long; lamina lanceolate, 30–80 by 7–10 cm. *Inflorescence* apical on a slender, branched, pale, burrowing stem with prominent bract scars. *Floral bract* appearing above the soil, purple, c. 7 cm long, sheathing the c. 10 cm long, white ovary extension, this curved just below the insertion of the perianth. *Sepals* whitish,



Fig. 1. *Orchidantha holttumii* K. Larsen. Base of plant with flower. Photograph A.D. Poulsen, at type locality, 1992.



Fig. 2. *Orchidantha holttumii* K. Larsen. a. Flower; b. androecium and gynoecium (Poulsen *et al.* 298). Drawing K. Tind. Reproduced with permission from Nordic J. Bot.

equal, lanceolate, cuspidate, c. 9 by 2 cm. *Lateral petals* dark purple, c. 3 by 1 cm, apical part with crenulate-undulate margin, apex cuspidate. *Labellum* dark purple, broadly lanceolate, c. 7 cm long, c. 2 cm broad in lower half, main vein thickened, raised on upper side, the apical part crenulate-undulate, incurved, forming a claw-like structure. *Stamens* c. 2 cm long. *Style* robust, c. 2 cm; stigma 3-fid, branches 8–10 mm, undivided, coarse. *Capsule* 25–30 cm, with a 2 cm long beak. *Seeds* not seen. — **Fig. 1, 2.**

Distribution — *Malesia*: Borneo: Brunei (Belait Distr., Labi, Kampung Teraja). Sabah (Sandakan, Kabilī F. R.).

Note — A sheet in K, *Keith 10013*, bears a label "Seeds-fruit studied for USDA Tech. Bull. — C.R. Gunn." However, there were no seeds in the capsule when Gunn studied the specimen (Gunn, pers. comm.).

4. *Orchidantha longiflora* (Scott.) Ridley

Orchidantha longiflora (Scott.) Ridley, Fl. Malay Penins. 4 (1924) 292; Keng, Gard. Bull. Sing. 24 (1969) 347; Holttum, Gard. Bull. Sing. 25 (1970) 245. — *Orchidantha longiflora* (Scott.) H.J.P. Winkl. in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 15a (1930) 541, nom. superfl. — *Lowia longiflora* Scott., Nuov. Giorn. Bot. Ital. 18 (1886) 308, t. 11; K. Schum. in Engl., Pflanzenr., fam. IV.45 (1900) 40, f. 10A, B. — Lectotype: *Scortechini 2023* (K lecto), see note.

Orchidantha calcarea M.R. Hend., Gard. Bull. Str. Settl. 7 (1933) 125. — Type: *Henderson 26023* (SING holo), Perak.

Leaves up to 75–100(–160) cm long; lamina c. 55 by 6 cm, base long decurrent and not sharply distinct from the c. 20 cm long petiole. *Flowers* solitary or in a few-flowered inflorescence; floral bracts 4–7 cm. *Sepals* 6–10 by 1.5 cm, oblong, with shortly narrowed to apiculate apex, edges \pm revolute, dark brown-purple towards apex, olive green with brown veins towards base. *Lateral petals* whitish, c. 28 by 3 mm, with long slender tip. *Labellum* 5–6 by 2.2–2.5 cm, base dark purple, lamina ovate, creamy white, strongly rugose with raised veins, apex with a triangular sinus (always?), c. 14 mm deep, the midrib ending in a mucro in the sinus. *Stamens* 12 mm, with short filaments, enlarged towards the base. *Ovary* 8–12 cm long including the extension, tinged with pink; style c. 1 cm long; stigma lobes purple, with truncate apices finely and irregularly toothed, midlobe c. 6 mm long, side-lobes shorter. Mature *capsules* not seen.

Distribution — *Malesia*: West Malaysia: Perak, Selangor.

Habitat & Ecology — Lowland evergreen dipterocarp forest, in damp places among leaf litter.

Note — Holttum was not able to trace Scortechini's specimen but there are three sheets in a type cover in K, all belonging to the *Scortechini 2023* collection from Perak. This collection has been selected as lectotype.

5. *Orchidantha maxillarioides* (Ridley) K. Schum.

Orchidantha maxillarioides (Ridley) K. Schum. in Engl., Pflanzenr., fam. IV.45 (1900) 42, f. 10C–G; Ridley, Fl. Malay Penins. 4 (1924) 293; Holttum, Gard. Bull. Sing. 25 (1979) 245. — *Protamomum maxillarioides* Ridley, Trans. Linn. Soc. II, 3 (1893) 383, t. 66. — *Lowia maxillarioides* (Ridley) Baker, Bot. Mag. (1894) t. 7351. — Type: *Ridley 2399* (SING holo), Pahang.

Leaves up to c. 75 cm long; lamina to 33 by 8.5 cm, sharply distinct from the slender, narrowly grooved, 20–40 cm long petiole. *Inflorescence* richly branched; floral bracts dark purple, c. 3.5 cm long. *Sepals* oblong acute, 3–3.2 by 4.5–5.5 cm, purplish, translucent, greenish towards apex. *Lateral petals* purplish with pale veins, oblong, c. 7 mm long, up to c. 2 mm wide. *Labellum* creamy coloured with faint purple mottling, especially towards apex, elliptic, c. 21 by 10 mm, apex rounded, basal 3–4 mm with sides upcurved; surface with c. 3 longitudinal folds on either side of a broad median band. *Stamens* white, up to 5 mm long including the short filaments. *Ovary* 5–5.5 cm long including the extension; style white, c. 4 mm long; stigma dark violet, c. 2 mm long, with 3 bilobed lobes with a small tooth in each sinus. *Capsule* 2.5–3 by 1.7 cm, triangular, at apex narrowed to a stiff appendage 15 mm long. *Seeds* 7 by 5 mm, hairy; aril of c. 6 stiff narrow lobes longer than seed. — **Fig. 3.**

Distribution — *Malesia*: West Malaysia: known only from few collections, all from Pahang.

Note — A plant grown in Singapore Botanic Gardens was studied by Holttum, who writes that the flowers have no perceptible odour. It is the only species which is commonly grown in greenhouses in Europe.

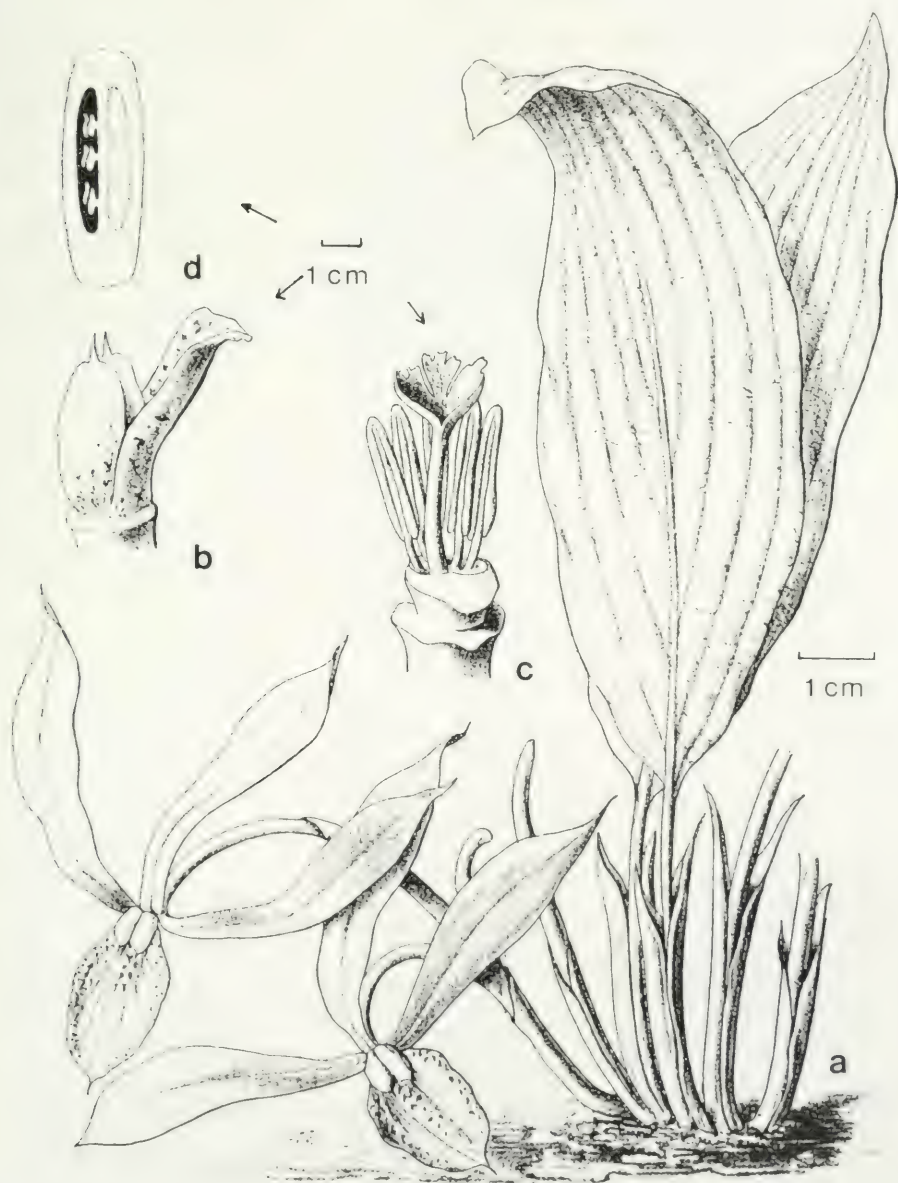


Fig. 3. *Orchidantha maxillarioides* (Ridley) K. Schum. a. Flowering plant; b. petals; c. androecium and style; d. ovary, section. Reproduced from Pflanzenreich IV.45.

6. *Orchidantha siamensis* K. Larsen

Orchidantha siamensis K. Larsen, Bot. Tidsskr. 56 (1961) 347, 348, f. 2, 3; in Fl. Thailand 2 (1972) 170, f. 10; Holtum, Gard. Bull. Sing. 25 (1970) 244. — Type: *Kerr 7148* (K holo), Thailand.

Leaves up to 60 cm long; petiole c. 30 cm long; lamina lanceolate, up to 30 by 6–7 cm, tapering at base. *Floral bract* greenish purple, c. 8 cm. *Inflorescence* few-flowered. *Sepals* dark purple, reflexed, linear-lanceolate, apiculate, subequal, 6.5–8 cm long, 8–10 mm wide. *Lateral petals* white, narrow, with dentate apex, 15–20 by c. 2.2 mm. *Labellum* c. 3 cm long, purplish green striate, basal part narrow, lamina white, sub-orbicular, emarginate, c. 2 by 2.2 cm, the median vein raised as a sharp fold. *Stamens* 10 mm long, filament c. 3 mm, enlarged towards the base. *Ovary* 14–20 cm long including the extension; style 10–15 mm long, stigma 15 mm long, with lacinate lobes, c. 6 mm long. *Capsule* 2.5–3 cm long with short beak. *Seeds* c. 7 mm long.

Distribution — Thailand (Peninsular, Narathiwat and Phatthalung provinces); *Malaysia*: West Malaysia (according to Kress in Smith et al. 1993).

Habitat — In Thailand in lowland evergreen dipterocarp forest; moist forest floor, together with other ombrophilous Zingiberaceous herbs such as *Scaphochlamys*, *Boesenbergia* and *Globba*.

INDEX TO SCIENTIFIC PLANT NAMES

Suprageneric epithets have been entered under the family name to which they belong preceded by the indication of their rank (subfamily, tribe, etc.). Infrageneric epithets have been entered immediately under the generic name to which they belong, preceded by the indication of their rank (subgenus, sections, etc.). Intraspecific epithets have been entered under the specific name to which they belong preceded by the indication of their rank (subspecies, variety, forma, etc.).

Synonyms have been printed in *italics*. Page numbers in **bold type** denote main treatment: an asterisk behind a page number denotes the presence of a figure of the concerned taxon.

- Abauria* Becc. 631
excelsa Becc. 632
Acrocarpus Wight ex Arnott 430, 432, 434, **435**
combretiflorus Teijsm. & Binnend. 438
fraxinifolius Arnott 436*, **438**
grandis (Miq.) Miq. 438
Afzelia J.E. Smith 431, 433, 435, **438**
acuminata (Merr.) Harms 441
borneensis Harms 441
coriacea Baker 697
javanica (Miq.) Léonard **439**, 440*
 subsp. *javanica* Léonard 439
 subsp. *longiflora* (de Wit) Léonard 439
palembanica (Miq.) Baker 623
rhomboidea (Blanco) Vidal 439, 440*, **441**
 var. *praetermissa* Léonard 441
Amherstia Wall. 430, 433, 434, **717**
 nobilis Wall. **717**
Alatota Aublet 573
bantamensis (Hassk.) Baillon 577
blancoi (Rolfé) Merr. 579
Asjogam Rheede 662
Asparagales 732
Asphodelaceae 732
 subfam. *Anthericoideae* 732
Baryxylum Lour. 650
Bauhinia L. 429, 432, 434, 435, **442**
 subg. *Bauhinia* Wunderlin **444**
 subg. *Elayuna* (Raf.) Wunderlin **444**, **456**
 (*Bauhinia*)
 subg. *Lasiobema* Korth. 458
 subg. *Phanera* (Lour.) Wunderlin **458**
 sect. *Austrocercis* (de Wit) Wunderlin 458, **498**
 sect. *Gigasiphon* (Drake) Harms 444
 sect. *Lasiobema* (Korth.) Benth. 458, **499**
 sect. *Loxocalyx* Benth. 458, 459
 sect. *Lysiphyllum* Benth. 458, **501**
 sect. *Palmatifolia* (de Wit) Wunderlin 458, **505**
 sect. *Phanera* (Lour.) Wunderlin **458**
 sect. *Pileostigma* Benth. 456
 sect. *Piliostigma* (Hochst.) Taub. 456
 sect. *Tubicalyx* Wunderlin 458, **532**
 ? *Griponeura* Korth. 456
acida Reinw. ex Korth. 457
acuminata L. 444, **445**, 446*
 var. *hirsuta* (Korth.) Craib 449
aherniana Perkins **461**, 491
 var. *aherniana* 461, **462**
 var. *subglabra* (Merr.) K. & S.S. Larsen 461, **462**
albolutea (Miq.) Prain 496
ampla Span. 445, **447**
 var. *ampla* **447**
 var. *schlechteri* (Harms) K. Larsen & Sunarno **447**
andersonii K. & S.S. Larsen 461, **463**, 464*
anguina Roxb. 500
 var. *horsfieldii* (Miq.) Prain 500
 (*Bauhinia*)
 antipolana Perkins 483, 485
 argentea (de Wit) Cusset 468
 audax (de Wit) Cusset 460, **463**
 bassacensis Pierre ex Gagnep. 459, **465**
 var. *backeri* (de Wit) S.S. Larsen 465, **466**
 var. *bakeri* 466
 var. *bassacensis* **465**
 baviensis Drake 455
bidentata Jack 506, **507**
 var. *bidentata* **508**
 var. *breviflora* (Ridley) K. & S.S. Larsen **508**
 var. *cornifolia* (Baker) Bennett 508, **509**
 var. *fraseri* (de Wit) K. & S.S. Larsen 508, **509**
 var. *gracilipes* (Merr.) K. & S.S. Larsen 508, **510**
 var. *monticola* (Ridley) K. & S.S. Larsen 508, **510**
bidentata Jack sensu Prain 508
binata Blanco **502**
blakeana Dunn 453
blancoi (Benth.) Baker 502
borneensis Merr. 490, 492
brachyscypha Baker 480, 481
bracteata auct. 465
breviflora Ridley 507, 508
burbridgei Stapf 507, **510**
calceicola Craib 499
calycina Ridley 463
campanulata S.S. Larsen 506, **511***
cancellata Ridley 529, 531
candida Aiton 454
candida auct. 445
cardiophylla Merr. 529, 532

(Bauhinia)

- castrata* Blanco 453
castrata Hassk. 457
chalcobapta Quisumb. & Merr. 483, 485
championi 443
copelandii Merr. 514, 516
cordifolia Roxb. 534
cornifolia Baker 507, 509
coromandeliana DC. 453
corymbosa Roxb. ex DC. 459, **466**, 534
corymbosa auct. 476
creaghii Baker 522, 523
cretacea 443
crudiantha (de Wit) Cusset 459, **467**
cucullata Desv. 535
cumingiana (Benth.) Fern.-Vill. 480
cuprea Ridley 506, **512**
curtisii Prain **499**
debilis Hassk. 500
decumbens Henders. 506, **513**
detergens Craib 465
dewitii K. & S.S. Larsen 502, **503**, 504*
diphylla auct. 502
diptera Blume ex Miq. 502, **503**
dolichocalyx Merr. 445, **448**
elmeri Merr. 506, **513**
elongata Korth. 451
emarginata auct. 527, 534
endertii K. & S.S. Larsen 460, **468**
excelsa (Blume ex Miq.) Prain 461, **469**
 var. *aurora* (de Wit) K. & S.S. Larsen 469, **470**, 471*
 var. *excelsa* **469**
 var. *megalantha* (Merr.) K. & S.S. Larsen 469
excurrens Stapf 460, **470**, 491
fabrilis (de Wit) K. & S.S. Larsen 460, **472***
ferruginea auct. 469
ferruginea Roxb. 460, **473**, 474*
 var. *ferruginea* **475**
 var. *griffithiana* (Benth.) Baker 473, **475**

(Bauhinia)

- finlaysoniana* (Grah.ex Benth.) Baker 506, **514**, 534
 var. *amoena* (de Wit) K. & S.S. Larsen **515**
 var. *finlaysoniana* **515**
 var. *leptopus* (Perkins) K. & S.S. Larsen 515, **516**
 var. *montana* (de Wit) K. & S.S. Larsen 515, **516**
flammifera Ridley 480
flava (de Wit) Cusset 499, **500**
fleurii Gagnep. 465
foraminifer Gagnep. 505, **516**
 var. *falcata* K. & S.S. Larsen 517*, **518**
 var. *foraminifer* **517***
francii K. & S.S. Larsen 506, **518**, 519
fulva Blume ex Korth. 460, **476**
galpinii N.E. Br. 444, **448**
glabrifolia (Benth.) Baker 459, **476**
 var. *maritima* K. & S.S. Larsen **476**
glabrifolia auct. 476
glabristipes (de Wit) Cusset 460, **477**
glauc (Benth.) Benth. 459, **478**
 subsp. *glauc* **478**
 subsp. *tenuiflora* (Watt ex C.B. Clarke) K. & S.S. Larsen 478
gracilipes Merr. 507, 510
gracillima (de Wit) Cusset 459, **478**
grandiflora Blanco 448
grandiflora auct. 445
griffithiana (Benth.) Prain 473, 475
hallieriana Elmer 461, 462
havilandii Merr. 506, **520***
hawkesiana F.M. Bailey 457
hendersonii (de Wit) Cusset 460, **479**
hirsuta Korth. 449
hirsuta Weinm. 444, **449**
holosericea Ridley 480
horsfieldii (Miq.) Macbride 500
hosei Merr. 514, 515
hullettii Prain 473, 475

(Bauhinia)

- inermis* Perr. 534
integrifolia Roxb. 459, **480**
 subsp. *cumingiana* (Benth.) K. & S.S. Larsen 480, **481**
 var. *cumingiana* 480, **481**
 var. *nymphaeifolia* (Perkins) K. & S.S. Larsen 480, **482**
 subsp. *integrifolia* **480**
kappleri Sagot 450
kingii Prain 506, **521**
kockiana Korth. 507, **522**
 var. *angustifolia* K. & S.S. Larsen 522, **523**
 var. *bakoensis* K. & S.S. Larsen 522, **523**
 var. *beccarii* K. & S.S. Larsen 522, **524**
 var. *brevipedicellata* K. & S.S. Larsen 522, **524**
 var. *calicicola* K. & S.S. Larsen 522, **524**
 var. *kockiana* 522, **523**
 var. *scarlatina* (Backer ex Camm.) K. & S.S. Larsen 522, **524**
 var. *sericeinervia* (de Wit) K. & S.S. Larsen 522, **525**
 var. *velutina* (de Wit) K. & S.S. Larsen 522, **525**
kostermansii K. & S.S. Larsen 460, **482***
krugii Urb. 450
lambiana Baker f. 506, **525**, 526*
latisiliqua Cavan. 534, 547
leptopus Perkins 514, 516
 f. *javanica* Backer 514, 515
lingua DC. 461, 473, **483**
 var. *antipolana* (Perkins) K. & S.S. Larsen 484, **485**
 var. *lingua* **484**
 var. *riedelii* (Baker) K. & S.S. Larsen 484, **485**
linnaei Ali 445
longipes Merr. 465, 466
lucida (Miq.) Prain 506, **527**
lunaria Cav. 535
macropoda Baker 480, 481
malabarica Roxb. **456**
megalantha Merr. 469

(Bauhinia)

- menispermacea* Gagnep. 506.
527
merrilliana Perkins 461. **485**
 var. *borneensis* K. & S.S.
 Larsen 485. **486***
 var. *merrilliana* 460. **485**.
 486*
micrantha Ridley 478
minahassae Koord. 483. 484
mirabilis Merr. 503
mollissima (Wall.) Prain 451
mollissima auct. 449
monandra Kurz 444. **450**
monticola Ridley 507. 510
moultonii Merr. 529. 532
nymphaeifolia Perkins 480.
 482
ornata Kurz 468. 535
pachyphylla Merr. 461. **487**
 var. *pachyphylla* **487**
 var. *wenzelii* K. & S.S. Lar-
 sen 487. **488**
parvifolia Teijsm. & Binnend.
 534
parvula Gagnep. 449
pauciflora Merr. 461. **488**
perkinsae Merr. 490
pinchotiana Perkins 483. 484
piperifolia auct. 476
platyphylla Zipp. ex Miq. 457
polycarpa Wall. ex Benth. 455
posthumi (de Wit) Cusset 506.
528
potosiana 443
pottsii G. Don 444. **450**
 var. *elongata* (Korth.) de
 Wit 451
 var. *mollissima* (Wall. ex
 Prain) K. & S.S. Larsen
 451
 var. *pottsii* **451**
 var. *subsessilis* (Craib) de
 Wit 451. **452**
 var. *velutina* (Wall. ex
 Benth.) K. & S.S. Larsen
 451. **452**
praesignis Ridley 460. **489**
pubescens DC. 454
punctata Bolle 448
purpurea L. 444. **452**
 var. *corneri* de Wit 453
 var. *violacea* de Wit 453
purpurea auct. 450. 457

(Bauhinia)

- purpurea* × *variegata* 453
pyrraneura 528
pyrrhoneura Korth. 506. **528**.
 534
rahmatii Merr. 460. **489**. 534
retusa Roxb. 535
ridleyi Prain 460. **490**
riedelii Baker 473. 483. 485
rosea Corner 453
rosulenta Ridley 529. 532
rufa (Grah. ex Benth.) Baker
 535
rugulosa Blume ex Miq. 457
sanitwongsei Craib 465
 var. *glauca* Craib 465
scandens L. 443. 499. **500**
 var. *horsfieldii* (Miq.) K. &
 S.S. Larsen 501
scandens auct. 466. 480. 481.
 483
scarlatina Backer ex Camm.
 524
schlechteri Harms 447
scortechinii Prain 507
semibifida Roxb. 461. **490**
 var. *acuminata* K. & S.S.
 Larsen 491. 492*. **493**
 var. *bruneiana* K. & S.S.
 Larsen 461. 491. 492*. **493**
 var. *longebracteata* K. &
 S.S. Larsen 491. 492*. **494**
 var. *perkinsae* (Merr.) K. &
 S.S. Larsen 491. **494**
 var. *semibifida* 491. **492***
 var. *stenostachya* (Baker)
 K. & S.S. Larsen 491. **494**
semibifida auct. 483
steenisi K. & S.S. Larsen 461.
494. 495*
stenostachya Baker 490. 494
stipularis Korth. 461. **496**
 var. *brachystylus* K. & S.S.
 Larsen 496. **497**
 var. *stipularis* **496**
stipularis auct. 473. 475
strychnoidea Prain **533**
subglabra Merr. 461. 462.
 491
subrhombicarpa Merr. 501
subrotundifolia Cav. 535
subrotundifolia auct. 450
subsessilis Craib 452
suffruticosa Ridley 473. 475

(Bauhinia)

- sylvani* (de Wit) Cusset 459.
497
teijsmanniana Scheff. 483.
 484
ternatensis Gagnep. 514. 516
timorana Decne. 455
timoriensis 455
tomentosa auct. 445. 457
tomentosa L. 445. **453**
triandra Roxb. 453
tubicalyx Craib **533**
vahllei 443
vahllei auct. 480. 481
variegata L. 444. **454**
 var. *alboflava* de Wit 454
 var. *candida* (Aiton) Corner
 454
velutina (Wall. ex) Baker 452
violacea Corner 453
viridescens Desv. 445. **455**
 var. *baviensis* (Drake) de
 Wit 455
viridiflora Backer 465. 466
warburgii Perkins 483. 484
whitfordii Elmer 480. 482
williamsii F. Muell. **498**
wrayi Prain 506. **529**
 var. *blumeana* K. & S.S.
 Larsen 530. **531**
 var. *borneensis* K. & S.S.
 Larsen 530. **531**
 var. *cancellata* (Ridley) K. &
 S.S. Larsen 530. **531**
 var. *cardiophylla* K. & S.S.
 Larsen 530. **532**
 var. *moultonii* (Merr.) K. &
 S.S. Larsen 530. **532**
 var. *rubella* (de Wit) K. &
 S.S. Larsen 530. **532**
 var. *sumatrana* Ridley 530.
 531
 var. *wrayi* **530**
xanthoneura Korth. 528
Bauhinia L. s. str. apud de Wit
 444
Behnia 731
Biasolettia Presl 746
nymphaeaeifolia Presl 747
Bonduc majus Medik. 548
Bracteolanthus de Wit 442. 458.
 501
dipterus (Blume ex Miq.) de
 Wit 503

- Brownea* Jacq. 430, 433, 434, 717, **718**
ariza Benth. **719**
capitella Jacq. 719, **720**
grandiceps Jacq. 719, **720**
hybrida Hort. ex Backer 719, **720**
Caesalpina 535
Caesalpinia L. 429, 432, 434, **535**
 sect. *Peltophorum* Vogel 650
acanthobotrya Miq. 555
andamanica (Prain) Hattink 537, **539**, 540*
arborea Zoll. ex Miq. 651
benguetensis Elmer 544
bonduc (L.) Roxb. 537, 538, **541**
borneensis Merr. 550
cinclidocarpa Miq. 555
coriaria (Jacq.) Willd. 536, 538, **541**
crista L. 537, 538, **542**
cucullata Roxb. 537, 538, **543**
dasyrhachis Miq. 650
decapetala (Roth) Alston 537, 538, **543**
digyna Rottl. 537, 538, **544**
enneaphylla Roxb. 537, 539, **545**
ferox Hassk. 544
ferruginea Decne. 651
furfuracea (Prain) Hattink 537, 539, **546**
glabra auct. 548
globulorum Bakh. f. & P. Roy-en 548
gracilis Miq. 544
hymenocarpa (Prain) Hattink 537, 539, **546**
inermis Roxb. 651
laevigata Perr. 542
latisiliqua (Cavan.) Hattink 537, 539, **547**
major (Medik.) Dandy & Exell 537, 538, **548**
marginata Roxb. 565
mindorensis (Merr.) Hattink 537, 539, **548**
minutiflora Elmer 550
nuga (L.) Ait. 542
oppositifolia Hattink 536, 538, **549**
(Caesalpinia)
parviflora Prain 537, 538, **549**
 var. *stipularis* Prain 550
 var. *typica* Prain 549
pubescens (Desf.) Hattink 537, 539, **550**
pulcherrima (L.) Swartz 536, 538, **551**
sappan L. 537, 538, **552**
scortechinii (F. Muell.) Hattink 537, 538, **552**
sepiaria Roxb. 543
sogerensis Baker f. 541
solomonensis Hattink 538, **553**
spicara Dalz. 536
spinosa (Molina) Kuntze 536
stipularis (Prain) Ridley 550
sumatrana Roxb. 537, 539, **553**, 554*
torquata Blanco 547
tortuosa Roxb. 537, 538, **555**
Caesalpiniaceae 409–730
 subfam. Brachystegioideae 428
 subfam. Caesalpinoideae **409**, 428
 tribe Amherstieae 413, 414, 416–418, 428
 tribe Caesalpinieae Polhill & Vidal 413, 416, 418, 428
 tribe Cassieae Bronn 413, 416–418, 428, 556
 tribe Cercideae Bronn 413, 416–418, 428
 tribe Detarieae DC. 412, 413, 416–418, 428
 tribe Macrolobieae Breteler 428, 429
Caju galedupa Rumph. 699
Cantuffa macroptera (Kurz) Kuntze 658
microphylla (Miq.) Kuntze 659
Casperea castrata (Hassk.) Hassk. 457
Caspariopsis monandra (Kurz) Britt. & Rose 450
Cassia L. 431, 433, 435, **556**
 subg. *Lasiorhagma* Vogel ex Benth. 565
 subg. *Senna* Benth. 673
 sect. *Lasiorhagma* Vogel 565
 absus L. 566
(Cassia)
adenantha Zoll. & Mor. 677
agnes (de Wit) Brennan 563
alata L. 675
arayatensis Llanos 689
arayatensis auct. 685
auriculata L. 690
bakeriana Craib **557**
bartonii F.M. Bailey 563
bicapsularis L. 676
bifida Zoll. & Moritz 677
biflora L. 691
borneensis Miq. 690
coluteoides Collad. 677, 683
didymobotrya Fresen. 690
divaricata Nees & Blume 677
fistula L. 556, **557**, 558*
floribunda auct. 684
florida Vahl 685
fruticosa Mill. 678
galegifolia L. 691
glauca Lam. 687
 var. *suffruticosa* (Roth) Baker 688
grandis L. f. 556, **559**
hirsuta L. 679
hirsuta auct. 680
indecora Humb. 683
javanica L. 557, **560**
 subsp. *agnes* (de Wit) K. Larsen 561, **563**
 subsp. *bartonii* (F.M. Bailey) K. Larsen 561, **563**
 subsp. *javanica* K. & S.S. Larsen **561**, 562*
 subsp. *microcalyx* (Irwin & Barneby) K. Larsen 561, **563**
 subsp. *nodosa* (Buch.-Ham. ex Roxb.) K. & S.S. Larsen 561, **564**
 subsp. *pubiflora* (Merr.) K. Larsen 561, **564**
 subsp. *renigera* (Wall. ex Benth.) K. Larsen 561, **564**
 var. *agnes* de Wit. 563
 var. *microcalyx* Irwin & Barneby 563
laevigata Willd. 684
laevigata auct. 676
leptocarpa Benth. 679
 var. *hirsuta* Benth. 680

(Cassia)

- leschenaultiana* DC. 566
 var. *auricoma* Grah. ex de Wit 567
longisiliqua Blanco 680
megalantha Decne. 560
mimosoides L. 567
 f. *perennis* de Wit 567
mindanaensis Merr. 569
montana auct. 689
multiglandulosa Jacq. 691
multijuga Rich. 680
nodosa Buch.-Ham. ex Roxb. 564
obtusifolia L. 681
occidentalis L. 681
 var. (β) *aristata* Collad. 683
pachycarpa de Wit 559
pallida Vahl 691
parahyba Vell. 728
pendula Humb. & Bonpl. ex Willd. 683
pumila Lam. 570
quadrangularis Zoll. & Mor. 684
reinwardtii Hassk. 683
renigera Wall. ex Benth. 564
roxburghii DC. 565
septentrionalis Viv. 684
siamea Lam. 685
sophora L. 686
spectabilis DC. 686
splendida Vogel 691
suffruticosa Roth 688
sulcata Blanco 680
sulfurea Collad. 687
sumatrana Roxb. ex Hornem. 685
surattensis Burm. f. 688
 f. *ferox* de Wit 687
 subsp. *glauca* (Lam.) K. & S.S. Larsen 687
 subsp. *suffruticosa* (Roth) K. & S.S. Larsen 688
 subsp. *surattensis* K. & S.S. Larsen 688
surattensis auct. 687
timoriensis DC. 689
 f. *xanthocoma* (Miq.) de Wit 689
 var. β *xanthocoma* (Miq.) Miq. 689
tomentosa L. f. 691

(Cassia)

- tora* L. 689
 τ *borneensis* Miq. 690
viscidia Zoll. & Mor. ex Zoll. 566
xanthocoma Miq. 689
Cathartocarpus bicapsularis (L.) Ham. 676
Chamaecrista Moench 431, 434, 435, **565**
absus (L.) Irwin & Barneby 565, **566**
leschenaultiana (DC.) Degener **566**
mimosoides (L.) Greene 566, **567**, 568*
mindanaensis (Merr.) K. Larsen 565, **569**
pumila (Lam.) K. Larsen 565, **570**
Cinclidocarpus Zoll. 535
nitidus Zoll. 555
Copaifera L. 430, 434, **570**
palustris (Sym.) de Wit 571, 572, **573**
Corysadenia Griff. 751
trifoliata Griff. 760
Corysadenia 751
Crudia Schreber 430, 433, 434, **573**
acuta de Wit **576**
bantamensis (Hassk.) Benth. 575, **577**, 578*
beccarii Ridley 576, **579**
blancoi Rolfe 576, **579**
bracteolosa de Wit 580
brevipes Ridley 583
caudata Prain 575, **580**
cauliflora Merr. 574, **581**
curtisii Prain 576, **581**
 var. *wallichii* Prain 597
curtisii auct. 584
dewitii Kosterm. 575, **582**
evansii Ridley 575, **583**
glauca Prain 581
gracilis Prain 575, **583**
havilandii Prain 596
katikii Verde. 575, **584**
lanceolata Ridley 576, **584**
mutabilis de Wit 574, **585**
orientalis Hassk. 597
ornata de Wit 575, 586*, **587**
papuana Kosterm. 575, **588**
penduliflora Ridley 575, **588**

(Crudia)

- reticulata* Merr. 574, **589**
reticulata auct. 587
ripicola de Wit 576, **590**
scortechinii Prain 576, **590**
sparei Whitmore 575, **591**
spicata auct. 579
splendens de Wit 574, **591**
subsimplicifolia Merr. 575, **592**
subsimplicifolia auct. 582
tenuipes Merr. 575, **593**
teysmannii de Wit 576, **593**
velutina Ridley 575, **594**
venenosa de Wit 576, **595**
viridiflora Whitmore 575, **595**
wrayi Prain 576, **596**
Crudya 597
Cynometra L. 431, 433, 434, **597**
acutiflora Vidal 602
alternifolia Elmer 628
bifoliolata Merr. 607
bijuga Span. ex Miq. 607
 var. *mimosoides* Merr. 604
brachymischa Harms **599**
cauliflora L. 598, 601*, **602**
 α *subsessilis* Hassk. 602
 β *elongatis* Hassk. 602
copelandii (Elmer) Elmer 598, **602**
densiflora Elmer 711
elmeri Merr. 599, **603***
inaequifolia A. Gray 599, **604**
inaequifolia auct. 603, 605
iripa Kostel. 599, **604**
katikii Verde. 598, **605**
luzoniensis Merr. 608
malaccensis Meeuwen 599, **605**
minutiflora F. Muell. 599, **605**
mirabilis Meeuwen 599, **606**
novoguineensis Merr. & L.M. Perry 599, **606**
polyandra Roxb. 644
 var. *kurzii* Prain 645
polyandra auct. 607
ramiflora L. 599, **607**
 subsp. *bijuga* Prain 607
 var. β Wight & Arn. 604
 var. *bifoliolata* (Merr.) Meeuwen **607**
 var. *mimosoides* Baker 604
 var. *ramiflora* **607**

(Cynometra)

- schumanniana* Harms 607
simplicifolia Harms 598, **608**
 var. *oblongata* Merr. 608
warburgii Harms 599, **608**
whitfordii Elmer 607

Dansera Steenis 608

- procera* Steenis 614

Delonix Raf. 430, 432, 434, 716,

721

- regia (Bojer ex Hook.) Raf.

721, 722*

Dialium L. 430, 433, 434, 435,

608

- subg. Arouna 608

- subg. *Dansera* (Steenis)

- Steyaert 608, 613

- subg. Dialium 609

- subg. *Uittienia* (Steenis)

- Steyaert 714

- ambiguum* Prain 612

- angustisepalum* Ridley 611

- cochinchinense* Pierre 612

- dewitiei* Steenis 613

- havilandii* Ridley 612

- hydnocarpoides* de Wit 608,

609

- indum L. **609**, 610*

- var. *bursa* (de Wit) Rojo

611, **612**

- var. *indum* **611**

- javanicum* Burm. f. 609, 611

- kingii* Prain 612

- kunstleri* Prain 609, **613**

- var. *kunstleri* **614**

- var. *trifoliolatum* (de Wit)

Rojo **614**

- laurinum* Baker 611

- var. *bursa* de Wit 611, 612

- maingayi* Baker 612

- marginatum* de Wit 611

- modestum* (Steenis) Steyaert

714

- patens* Baker 611

- platysepalum* Baker 609, **612**

- var. *ambiguum* (Prain) Ridley 612

- var. *burong* Prain 612

- var. *papan* Prain 612

- var. *wallichii* Baker 612

- praetermissum* de Wit 609

- procerum* (Steenis) Steyaert

609, **614**, 615*

- silvestre* de Wit 613, 614

(Dialium)

- trifoliolatum* de Wit 613, 614

- triste* de Wit 612

- turbatum* de Wit 611

- wallichii* (Baker) Prain 612

Dianella 732

Dianellaceae 732

Doryanthaceae 732

Doryanthes 732

Echinocalyx Benth. 691, 698

Elachanthera 731

Elayuna Raf. 456

Endertia Steenis & de Wit 431,

434, 435, **616**

- spectabilis Steenis & de Wit

617*, **618***

Eperua 417

- falcata* auct. 441

- rhomboidea* Blanco 441

Erythrophleum densiflorum

Merr. 711

- densiflorum* auct. 713

- unijugum* Airy Shaw 713

Eustrephus R. Br. 731, 732, **733**

- angustifolius* R. Br. 733

- latifolius* R. Br. **733**, 734*

- var. *angustifolius* (R. Br.)

Benth. 733

- timorensis* Ridley 736

Folium linguae Rumph. 483*Galedupa ceramensis* Rumph.

699

- indica* Lam. 699

Geitonoplesiaceae 731–736

Geitonoplesium A. Cunn. ex

Hook. 731, 732, **733**

- cymosum* (R. Br.) Hook. 735*,

736*Gigasiphon* Drake 442, 444

- amplum* (Span.) de Wit 447

- dolichocalyx* (Merr.) de Wit

448

- schlechteri* (Harms) de Wit

447

Gleditschia 619

- celebica* Koord. 621

- copelandii* Elmer 602

Gleditsia L. 429, 432, 434, **619**

- rolfei* Vidal 620, **621**

Gronovia Blanco 751

- ternata* Blanco 756

Guilandina L. 535

- bonduc* L. 541

- nuga* L. 542

Gyrocarpaceae 738

- subfam. Gyrocarpoideae 738,
761

- subfam. Hernandioideae 738

Gyrocarpus Jacq. 737, **742**

- americanus* Jacq. 738, 742,

743*, 744*, 745

- subsp. *americanus* Kubitzki

743

- asiaticus* Willd.

- var. *javanicus* Meisn. 745

- hababensis* Domin 742

- jacquini* Gaertn. 743

- var. *javanicus* Domin 745

- jatrophiifolius* Chiov. 742

- lobatus* Blanco 743

- rugosus* R. Br.

- var. *philippinensis* Meisn.

745

Haematoxylum L. 429, 432, 716,

723

- campechianum* L. **723**

Halesia ternata Blanco 756Hardwickia *alternifolia* Elmer

628

Henschelia Presl 751

- luconensis* Presl 756

Hernandia L. 737, 742, **746**

- bivalvis* Benth. 746

- cordigera* Vieillard 747

- javanica* Tuyama 749

- moerenhoutiana* Guill. **746**

- subsp. *campanulata* 747

- subsp. *moerenhoutiana* 747

- subsp. *samoensis* 747

- subsp. *samoensis* auct. 746

- nymphaeifolia* (Presl) Kubitz-

ki 738, 746, **747**, 748*

- ovigera* L. 746, **749**, 750*, 751

- papuana* C.T. White 749

- peltata* Meisn. 747

- voyroni* Jum. 746

Hernandiaceae 737–761*Hernandieae* 737

Herpolirion 732

Hymenaea L. 431, 434, 717, **724**

- courbaril* L. **724**

- var. *courbaril* **725**

- verrucosa* Gaertn. 724, **725**

Illigeria Blume 737, 742, **751**

- appendiculata* Blume **752**

- subsp. *appendiculata* **753**

- subsp. *stenoptera* Kubitzki

753

(Illigera)

- appendiculata* auct. 758, 759, 760
cardiophylla Merr. 756
celebica Miq. 752, 754*, **755**
coryadenia Meisn. 760
dasyphylla Miq. 760
diptera Elmer 757
dubia Span. 753
elegans Duyfjes 752, **756**
elliptifolia Merr. 757
khasiana Clarke 758
kurzii Clarke 760
lucida Teijsm. & Binn. 759
lucida auct. 759
luzonensis (Presl) Merr. 752, **756**
madagascariensis Perrier de la Bâthie 756
megaptera Merr. 752, 754*, **757**
meyeniana Kunth ex Walp. 756
novoguineensis Kubitzki 752, **758**
ovatifolia Quisumb. & Merr. 755, 756
parviflora Dunn 752, **759**
platyandra Dunn 755
pubescens Merr. 756
pulchra Blume 752, **759**
reticulata Merr. 756
ternata (Blanco) Dunn 756
trifoliata (Griff.) Dunn 752, **760**
 var. *dasyphylla* (Miq.) Kubitzki 760
Inga pterocarpa DC. 651
Intsia Thouars 431, 434, 435, **622**
 acuminata Merr. 441
 acuminata auct. 623
 amboinensis DC. 623
 bijuga (Colebr.) Kuntze 622, **623**, 624*
 madagascariensis Thouars ex DC. 623
 palembanica Miq. 622, **623**, 624*
 plurijuga Harms 623
 puberula Miq. 439
 rhomboidea (Blanco) Kuntze 441

- Jonesia* Roxb. 660
 asoca Roxb. 662
 confusa Hassk. 662
 declinata Jack 665
 declinata auct. 671
 minor Zoll. & Moritzi 668
 palembanica Miq. 665
 pinnata Willd. 662
 scandens Roxb. 673
Kalappia Kosterm. 430, 433, 435, **625**
 celebica Kosterm. **625**, 626*
Kingiodendron Harms 430, 433, 435, **627**
 alternifolium (Elmer) Merr. & Rolfe **628**, 629*
 alternifolium auct. 630
 novoguineense Verdc. 628, **630**
 platycarpum auct. 630
 tenuicarpum Verdc. 628, **630**
Koompassia Maingay ex Benth. 430, 433, 435, **631**
 beccariana Taub. 634
 excelsa (Becc.) Taub. 631, **632**
 grandiflora Kosterm. 631, **632***
 malaccensis Maingay ex Benth. 631, **634**
 parvifolia Prain 632
Lasiobema Korth. 442, 499
Lasiobema (Korth.) Miq. 458, 499, 532
 anguinum (Roxb.) Miq. 500
 curtisii (Prain) de Wit 499
 flavum de Wit 500
 horsfieldii Miq. 500
 retusa (Roxb.) de Wit 535
 scandens (L.) de Wit 500
 var. *horsfieldii* (Miq.) de Wit 501
 strychnoideum (Prain) de Wit 533
 tubicalyx (Craib) de Wit 533
Leguminosae
 subfam. **Caesalpinioideae**
 409–730
Leucostegane Prain 431, 433, 435, **635**
 grandis Ridley **636**, 637*
 latistipulata (Prain) Prain **636**, 637*
Lowia Scort. 763, 768
 longiflora Scort. 763, 772

Lowiaceae 763–774

- Luzuriaga* R. Br. 731
 aspericaulis Hallier f. 736
 cymosa R. Br. 736
 latifolia (Ker Gawl.) Poir. 733
 laxiflora Hallier f. 736
Luzuriaga auct. 733
Luzuriagaceae 731
Lysiphyllum (Benth.) de Wit 442, 458, 501
 binatum (Blanco) de Wit 502
Macrolobium amboinense Teijsm. ex Hassk. 623
 bijugum Colebr. 623
Maniltoa Scheff. 431, 433–435, **638**
 brassii Merr. & Perry **640**, 646*
 browneoides Harms **640**
 cynometroides Merr. & Perry 639, **641**
 fortuna-tironis Verdc. 640, **642**
 gemmipara Scheff. ex Backer 641
 grandiflora auct. 641, 648
 holirungii Harms 648
 hunsteiniana Harms 645
 lenticellata C.T. White 639, **642**
 var. *lenticellata* **642**
 var. *villosa* Verdc. **643**
 marietae Meeuwen 640, **643**, 646*
 megalocephala Harms 640, **643**
 peekelii Harms 648
 plurijuga Merr. & Perry 640, **644**
 polyandra (Roxb.) Harms 639, **644**
 var. *kurzii* (Prain) Meeuwen **645**
 var. *polyandra* **645**
 psilogyne Harms 639, **645**
 rosea (K. Schum.) Meeuwen 640, 646*, **647**
 schefferi K. Schum. 639, **648**
 var. *peekelii* (Harms) Verdc. **648**
 var. *schefferi* **648**
 steenisi Meeuwen 640, **649**
 var. *rodneyensis* Verdc. **649**
 var. *steenisi* **649**
 urophylla Harms 647

- Mezoneuron* Desf. 535
andamanicum Prain 539
benguetense (Elmer) Elmer 544
cabadbarenses Elmer 547
cucullatum (Roxb.) Wight & Arn. 543
emneophyllum (Roxb.) Wight & Arn. ex Benth. 545
furfuraceum Prain 546
glabrum Desf. 550
glabrum auct. 547
hymenocarpum Prain 546
koordersii Backer 553
kunstleri Prain 539
latisiliquum (Cavan.) Merr. 547
macrophyllum Blume ex Miq. 543
mindorenses Merr. 548
 var. *inermis* Merr. 549
peekelii Harms 553
platycarpum Merr. 547
pubescens Desf. 550
rubrum Merr. 547
scortechinii F. Muell. 552
sulfureum Miq. 553
sumatranum (Roxb.) Wight & Arn. ex Miq. 553
 var. β Miq. 553
Mezoneurum grande Miq. 438
Mimosa membranulacea Blanco 658
Monoteles Raf. 442
 Musaceae Juss. 764
 subfam. Lowioideae 764
 tribe Lowieae 764
 tribe Museae 763
 tribe Zingibereae 763
Orchidantha N.E. Br. 763, 764, **767**
 borneensis N.E. Br. 763, **768**
 calcareae M.R. Hend. 772
 fimbriata Holtum 764, 765, **768, 769**
 holtumii K. Larsen 765, 767, 768, **769**, 770*, 771*
 longiflora (Scort.) Ridley 764, 767, 768, **772**
 longiflora (Scort.) Winkl. 772
 maxillarioides (Ridley) K. Schum. 767, 768, **772**, 773
 siamensis K. Larsen 764, 767, 768, **774**
Outea bijuga DC. 623
Pahudia Miq. 438
 acuminata Merr. 441
 borneensis (Harms) Merr. 441
 javanica Miq. 439
 subsp. *eujavanica* de Wit 439
 subsp. *javanica* 439
 subsp. *longiflora* de Wit 439
 puberula (Miq.) Meijer Drees 439
 rhomboidea (Blanco) Prain 441
 var. *praetermissa* de Wit 441
Parkinsonia L. 429, 432, 434, 716, **726**
 aculeata L. **726**
Pauletia Cav. 442
 acida (Reinw. ex Korth.) Hassk. 457
Peltophorum (Vogel) Benth. 430, 432, 434, 435, **650**
 dasyrhachis (Miq.) Kurz **650**
 ferrugineum (Decne.) Benth. 651
 var. *glanduliferum* Koord. & Valeton 651
 grande Prain 650
 inermis (Roxb.) Llanos 651
 pterocarpum (DC.) Backer ex K. Heyne 650, **651**, 652*
 racemosum Merr. 650, **653**
Phanera Lour. 442, 458
 subg. *Austrocercis* de Wit 498
 subg. *Biporina* de Wit
 sect. *Bifoliolata* de Wit 505
 sect. *Cinnamomifolia* de Wit 505
 sect. *Palmatifolia* de Wit 505
 subg. *Phanera*
 sect. *Meganthera* de Wit 458
 sect. *Micranthera* de Wit 459
 sect. *Phanerosiphon* de Wit 459
 acuminatissima Miq. 528
 aherniana (Perkins) de Wit 461
 albolutea Miq. 496
 argentea de Wit 468
 audax de Wit 463
 bassacensis (Pierre ex Gagn.) de Wit 465
 var. *backeri* de Wit 466
 blancoi Benth. 502
 cardiophylla (Merr.) de Wit 529, 532
 catalpaefolia Miq. 528
 complicata Miq. 502
 corymbosa (Roxb. ex DC.) Benth. 466
 crudiantha de Wit 467
 cumingiana Benth. 480, 481
 cuprea (Ridley) de Wit 512
 dasycarpa Miq. 534
 var. *ridleyi* (Prain) de Wit 490
 debilis (Hassk.) Miq. 500
 decumbens (Henderson) de Wit 513
 diptera (Blume ex Miq.) Miq. 503
 elmeri (Merr.) de Wit 513
 elongata (Korth.) Benth. 451
 excelsa Blume ex Miq. 469
 var. *aurora* de Wit 469, 470
 var. *megalantha* (Merr.) de Wit 469
 ferruginea (Roxb.) Benth. 473
 finlaysoniana Grah. ex Benth. 514
 var. *amoena* de Wit 514, 515
 var. *javanica* (Backer) de Wit 514, 515
 var. *leptopus* (Perkins) de Wit 514, 516
 var. *montana* de Wit 514, 516
 foraminifer (Gagnep.) de Wit 516
 fulva (Blume ex Korth.) Benth. 476
 glabrifolia Benth. 476
 glabrifolia auct. 476
 glabristipes de Wit 477
 glauca Wall. ex Benth. 478
 gracillima de Wit 478
 griffithiana Benth. 473, 475

(Phanera)

- hendersonii* de Wit 479
hullettii (Prain) de Wit 473
integrifolia (Roxb.) Benth. 480
 subsp. *cumingiana* (Benth.) de Wit 481
 var. *nymphaeifolia* (Perkins) de Wit 482
junghuhniana Benth. 480
kockiana (Korth.) Benth. 522
 var. *burbidgei* (Stapf) de Wit 510
 var. *sericeinervia* de Wit 525
 var. *velutina* de Wit 525
lambiana (Baker f.) de Wit 525
lingua (DC.) Miq. 483
lucida (Wall. ex Benth.) Miq. 527
menispermacea (Gagnep.) de Wit 527
merrilliana (Perkins) de Wit 485
moultonii (Merr.) de Wit 529, 532
 var. *rubella* de Wit 529, 532
nicobarica Balakr. & Thoth. 496
pachyphylla (Merr.) de Wit 487
pauciflora (Merr.) de Wit 488
polyantha Miq. 480
posthumi de Wit 528
praesignis (Ridley) de Wit 489
punctata (Bolle) Britt. 448
purpurea (L.) Benth. 453
pyrrhoneura (Korth.) Benth. 528
riedelii (Baker f.) de Wit 483, 485
 var. *fabrilis* de Wit 472
rufa Benth. 468, 535
scandens (L.) Raf. 500
scarlatina (Backer ex Camm.) de Wit 524
semibifida (Roxb.) Benth. 490
 var. *excurrans* (Stapf) de Wit 470
 var. *stenostachya* (Baker) de Wit 490, 494
 var. *subglabra* (Merr.) de Wit 461, 462

(Phanera)

- stipularis* (Korth.) Benth. 496
sumatrana Miq. 490, 492
sylvani de Wit 497
teijsmanniana (Scheff.) Warb. 483
vahlil auct. 480, 481
variegata (L.) Benth. 454
velutina Benth. 452
williamsii (F. Muell.) de Wit 498
wrayi (Prain) de Wit 529
wrayi var. *cancellata* (Ridley) de Wit 529, 531
 Philesiaceae 731
 Phormiaceae 731, 732
 Phormium 732
Piliostigma Hochst. 442, 456
acidum (Reinw. ex Korth.) Benth. 457
malabaricum (Roxb.) Benth. 457
Poinciana L. 535
coriaria Jacq. 542
pulcherrima L. 551
regia Bojer ex Hook. 721
Protanomum Ridley 768
maxillarioides Ridley 764, 772
Pryona Miq. 573
bantamensis (Hassk.) Miq. 577
Pseudocynometra Kuntze 638
browneoides (Harms) Kuntze 640
hollrungii (Harms) Kuntze 648
schefferi (K. Schum.) Kuntze 648
Pseudosindora Sym. 570
palustris Sym. 573
Pterolobium R. Brown ex Wight & Arn. 432, 435, **654**
borneense Merr. **655**
densiflorum 655 656*, **657**
indicum A. Rich.
 var. *macropterum* (Kurz) Baker 658
 var. *microphyllum* (Miq.) Baker 659
indicum auct. 658
insigne Blume ex Miq. 659
lacerans auct. 658
macropterum Kurz 655, **658**

(Pterolobium)

- membranulaceum* (Blanco) Merr. 655, 656*, **658**
microphyllum Miq. 655, **659**
Reichardia decapetala Roth 543
pentapetala Blanco 658
Rhynchocharpa monophylla Backer ex K. Heyne 614
Saraca L. 431, 434, **660**, 663*
arborescens Burm. f. 668
asoca (Roxb.) W.J. de Wilde **662**, 663*
bijuga Prain 668
cauliflora Baker 671
celebica W.J. de Wilde 661, 663*, **664**
confusa (Hassk.) Backer 662
crassifolia Ridley 665
declinata (Jack) Miq. 661, **665**, 666, 667
declinata auct. 671
elegans Ridley 665
elmeri Ridley 665
hullettii Prain 661, **667**
indica auct. 662
indica L. 662, 663*, **668**, 669
 var. *bijuga* Gagn. 668
 var. *zollingeriana* (Miq.) Gagn. 668
kunstleri Prain 668
lanceolata Merr. 665
latistipulata Prain 636
longistyla Ridley 665
macroptera Miq. 665
 var. *parviflora* Prain 665
 var. *typica* Prain 665
minor (Zoll. & Moritz) Miq. 668
 var. *bijuga* Prain 668
 var. *typica* Prain 668
monadelphica W.J. de Wilde 661, **670**
palembanica (Miq.) Baker 665
thaipingensis Cantley ex Prain 661, **671**
triandra auct. 665
tubiflora W.J. de Wilde 661, **672**
zollingeriana Miq. 668
Schizolobium Vogel 430, 432, 435, 716, **728**
excelsum Vogel 728
parahybium (Vell.) Blake 727*, **728**

Schizoscyphus K. Schum. ex
Taub. 638
roseus (K. Schum.) Warb.
647

Schizosiphon K. Schum. 638
roseus K. Schum. 647

Scitamineae R. Br. 763

Senna Mill. 431, 433, 434, 435,
673

sect. *Psilorhegma* (Vogel) Irwin & Barneby 688

absus (L.) Roxb. 566

alata (L.) Roxb. 674, **675***

auriculata (L.) Roxb. 690

bicapsularis (L.) Roxb. 674,
676

var. *bicapsularis* 677

didymobotrya (Fresen.) Irwin & Barneby 690

divaricata (Nees & Blume)
K. Larsen 674, **677**

fruticosa (Mill.) Irwin & Barneby 674, **678**

galegifolia (L.) Barneby & Lourt. 691

hirsuta (L.) Irwin & Barneby
674, **679**

var. *hirsuta* 679, **680**

var. *puberula* Irwin & Barneby 679, **680**

multiglandulosa (Jacq.) Irwin & Barneby 691

multijuga (Rich.) Irwin & Barneby 674, **680**

obtusifolia (L.) Irwin & Barneby 674, **681**

occidentalis (L.) Link 674,
681, 682*

pallida (Vahl) Irwin & Barneby 691

pendula (Willd.) Irwin & Barneby 674, 677, **683**

septemtrionalis (Viv.) Irwin & Barneby 674, **684**

(Senna)

siamea (Lam.) Irwin & Barneby 674, **685**

sophora (L.) Roxb. 674, **686**

spectabilis (DC.) Irwin & Barneby 674, **686**

splendida (Vogel) Irwin & Barneby 691

sulfurea (Collad.) Irwin & Barneby 674, **687**

sumatrana (Roxb. ex Hornem.) Roxb. 685

surattensis (Burm. f.) Irwin & Barneby 674, **688**

timoriensis (DC.) Irwin & Barneby 674, **689**

tora (L.) Roxb. 674, **689**

Serianthes gigalobium Kosterm. 713

Sindora Miq. 431, 433, 434, 435,
691

affinis de Wit 692, 693, **694**

beccariana Baker ex de Wit
693, **694**, 705*

bruggemanii de Wit 693, **695**,
696*

coriacea (Baker) Prain 692,
694, **697**

echinocalyx (Benth.) Prain
692, 693, **698**

galedupa Prain 692, 694, **699**

inermis Merr. 692, 694, **700**

intermedia (Baker) Prain 708

irpicina de Wit 693, **700**

javanica (Koord. & Valeton)
Backer ex K. Heyne 692,
693, **701**

leiocarpa Backer ex de Wit
692, 694, **702**

mucronata Pierre 707

parvifoliola Symington 707

siamensis Teijsm. ex Miq.
692, 693, **703**

var. *siamensis* **703**

(*Sindora*)

sumatrana Miq. 692, 693, **704**,
705*

var. *javanica* Koord. & Valeton 701

supa Merr. 692, 693, **706**

velutina Baker 693, **707**

wallichiana 708

wallichii Benth. 692, 693,
708

var. *intermedia* auct. 706

var. *intermedia* Baker 708

var. *siamensis* (Teijsm. ex Miq.) Baker 703

wallichii auct. 698, 706

Smilacaceae 731

Sparattanthelium Mart. 737

Stypandra 732

Sympetalandra Stapf 430, 431,
432, 434, **709**

borneensis Stapf **710**

borneensis auct. 711, 713

densiflora (Elmer) Steenis
710, **711**

hildebrandii Steenis 710, **711**,
712*

schmutzii Steenis 710, **713**

unijuga (Airy Shaw) Steenis
710, 712*, **713**

Tamarindus L. 431, 433, 717,
728

altera Rumph. 612

indica L. **729***

Touchiroa Aublet 573

bantamensis Hassk. 577

Tournaya Schmitz 501

Trachylobium Hayne 724

verrucosum (Gaertn.) Oliv.
725

Uittienia Steenis 430, 433, 435,
714

modesta Steenis **714**, 715*

Vittienia 714

Zingiberales 763



3 5185 00209 8232

(continued from inside front cover)

Podocarpaceae	10: 351	Saururaceae	4: 47	Thymelaeaceae	
Podostemaceae	4: 65; 6: 963	Scyphostegiaceae		4: 349; 6: 1, 976; 7: 830	
Polemoniaceae	4: 195		5: 297; 6: 967	Trapaceae	4: 43
Polygalaceae	10: 455	Simaroubaceae	6: 193, 968	Trigoniaceae	4: 59
Pontederiaceae	4: 255	Sonneratiaceae		Trimeniaceae	10: 327
Portulacaceae	7: 121		4: 280, 513; 6: 973	Triuridaceae	10: 109
Primulaceae	6: 173	Sparganiaceae	4: 233; 10: 718	Turneraceae	4: 235
Proteaceae	5: 147	Sphenocleaceae	4: 27	Typhaceae	4: 242; 6: 982
Punicaceae	4: 226	Sphenostemonaceae	10: 145	Ulmaceae	8: 31
Restionaceae	5: 416	Stackhousiaceae	4: 35	Umbelliferae	4: 113, 595
Rhizophoraceae		Staphyleaceae	6: 49		5: 555; 6: 983
5: 429; 6: 965; 8: 550		Stemonaceae	11: 399		7: 830; 9: 569
Rosaceae	11: 227	Stylidiaceae	4: 529; 6: 976	Valerianaceae	4: 253
Sabiaceae	10: 351	Styracaceae	4: 49; 9: 568	Violaceae	
Salicaceae	5: 107	Symplocaceae		7: 179, 831; 10: 720	
Salvadoraceae	4: 224	8: 205; 9: 569; 10: 718		Xyridaceae	
Sapindaceae	11: 419	Taccaceae	7: 806	4: 366, 598; 9: 571	
Sarcosperma(ta)ceae	4: 32	Taxaceae	10: 347	Zygophyllaceae	4: 64

Index to revised families in Series II (Pteridophyta)

Cyatheaceae	1: 65	Lindsaea group	1: 177	Tectaria group	2: 1
Gleicheniaceae	1: 1	Lomariopsis group	1: 255	Thelypteridaceae	1: 331
Isoetaceae	1: 62	Schizaeaceae	1: 37		



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